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THE BASIS AND OBJECT OF ARCHEOLOGICAL RESEARCH IN MEXICO AND ADJOINING COUNTRIES[1]

By the mutual agreement between the government of Mexico and other governments and scientific societies of Europe and America, it has been decided to establish an International School of American Archeology and Ethnology in the City of Mexico; and as the honor of being the first director of the school has fallen to my share, I beg leave to place before this illustrious assembly the reasons which determined the patrons and protectors of the school to found it, and to dwell a little more fully on the ends that we hope to achieve in this new institution.

We call our school the "International School of American Archeology and Ethnology;" that is to say, we wish to treat two sciences, the importance of which is more and more clearly recognized in our day, and which are in reality sisters—for what we call archeology is but a branch of ethnology, from which it differs rather in method than in aim. Archeology has reached its highest development and

[1] Inaugural address of the director at the opening of the International School of American Archeology and Ethnology in Mexico City on January 20. Porfirio Diaz, president of the Mexican republic, opened the school in the presence of the ministers of state and public instruction of the republic, of the ambassadors of countries that participate in the establishment of the school, and of many prominent citizens. After the inaugural address by Professor Seler and an address by Señor Ezequiel A. Chávez, subsecretary of public instruction, who dwelt on the importance of international cooperation in the establishment of the school, the president declared the school opened.

achieved its greatest triumphs in classical archeology and in the prehistoric archeology of Europe. For centuries the political and civil history of the Romans, Greeks and Oriental nations have been taught in the schools of the Old World. By the efforts of thousands of learned and industrious investigators, whatever knowledge could be obtained from descriptions and reports of historians, from the study of monuments that have survived the destruction of the old world, has been recorded and secured for the benefit of scientists and of the general public. We may say without exaggeration that an exact knowledge of the political and social life and of the characteristics of the individual life of the people of antiquity; a true concept of the extent of the influences arising therefrom, of the influences these civilizations received from the neighboring countries, and of the source from which they sprang,—was not attained until ancient history applied archeological methods, until by the use of the spade were unearthed the homes, graves, utensils, arms, ornaments, costumes, the remains of human bodies, and the worm-eaten literature of that ancient people.

Thus it was proved that field work was most necessary for the progress of archeology; underground lie the documents, truthful witnesses of the ancient civilizations about which we read; underground lie also the remains that are witnesses of civilizations, and the forms of primitive development of which no historian has written a single word. It is only necessary to bring them to light. However, for this kind of work, the energies of a single man are insufficient, no matter how skillful, diligent or learned he may be. Nor are the means sufficient which a scientist standing alone has at his disposal.

For these reasons in different countries of the European continent, the governments have taken upon themselves to establish and support institutions, to appoint directors and assistants who are charged with the task of exploring the centers of ancient civilizations, in the classic soil of Italy, Greece, Egypt, Babylonia, Assyria and other parts of the world. Associations of private citizens interested in this subject compete with the governments. In this way were organized the French, German, English and Austrian schools and those of the United States of America and other nations; in Rome, Athens, Smyrna, Cairo, Crete, Babylon, etc.

In establishing the institutions, the governments, scientists and scientific societies had a double purpose. The first and foremost was of course to learn as accurately and as completely as possible the characteristics of that great civilization whose heirs are we who live in Europe now, and which has spread to this continent and to other parts of the world. To accomplish this purpose it was important to preserve the relics that were found, to collect small objects and to note the places where they were discovered and the manner in which they had been deposited, and to keep them in museums.

The other object which the governments and scientific associations wished to attain was more particularly of an educational character. This purpose was partly accomplished by the museums, which were enriched by the finds made by archeological research. The peculiar traits as well as the artistic character of the remains that had been collected were admirably adapted to impress the imagination and to teach the young. There are, however, a great many things which can not be kept in museums, and there are many others which can only be seen and studied in the museums of the countries in which they have been found.

There are—most important of all—the people, the descendants of the ancient civilized nations; their countries, their skies, their climate, their whole environment, their way of living and the whole combination of imponderable agencies, the knowledge of which enables the student to understand the thousand peculiarities of the life and fate of the people. All of these and the particular methods of investigation were what was desired to teach the young in the schools of archeology that have been established with so much liberality in the classic countries of the Old World.

Work of this kind has been in operation for generations and with marked success. Whole cities arose anew from the accumulation of débris of thousands of years that had covered them; temples with rich ornamentation were restored, the secrets of the Egyptian pyramids, of the temples of Babylonia and Assyria, were brought to our view, together with countless objects, many of which were of inestimable value. These were preserved to delight the eye and satisfy the mind of mankind, and from them many students have learned to see, understand and work.

On the American continent, in the United States and in the Dominion of Canada, great interest was manifested in the ethnology of the Indian races and in its antiquities ever since the middle of the past century. Scientific associations and private parties rivalled in collecting data and documents; and the governments, aided by liberal means, undertook the direction of the investigation. Recently archeological investigations have also been instituted on a larger scale in South America in the Argentine Republic, particularly in the Andean region of that republic. Something has also been done in Brazil, Bolivia, Peru and Ecuador, by the cooperation of private parties, institutions of the United States and the governments of South America. Some foreigners have also worked in the republics of Central America, as well as in Yucatan and Chiapas: the Englishman Alfred P. Maudslay; the Frenchman Désiré Charney; the investigators of the Peabody Museum of Cambridge, Mass.; the Germans Berendt and Teoberto Maler; the Swedes Bovallius and Hartman. Great additions to our knowledge of the ancient peoples of those regions were derived from their work. In Mexico the explorations authorized by the government in Xochicalco, Cempoallan, Monte Alban and Teotihuacan have contributed much to enlarge and deepen our knowledge. Magnificent monuments which were little known, and which were covered by débris or hidden by tropical vegetation, were unveiled. This work awakened more and more interest among the educated classes of other countries, and especially among our neighbors to the north. Thus arose the idea of cooperation, of the union of efforts, of the necessity of establishing a center to direct the work, at which the young student can learn, who, full of enthusiasm for those studies, might wish to come here to learn what books and the objects accumulated in museums could not teach him. This was the object and aim in founding a school of the same kind as existed in Rome, and with the same aims, but international in character. It is not necessary to enter into details to show the particular opportunities of such a school in this country, but we shall be grateful to those who initiated and fathered the idea, for the zeal and perseverance with which they worked to accomplish their end. We must be grateful particularly to the government of this republic, that owns this soil, and to the ministry of public instruction, whose solicitude for the study and preservation of all the archeological treasures of this country is

well known, and which with great kindness supported the project and lent it its efficient aid.

Permit me now to set forth in a few words the tasks that this new institution will have to take up, and the way in which I think the work should proceed.

The historian places the highest value on the testimony he can gather from living witnesses. The descendants of the ancient peoples of this country, in so far as they still speak their old languages and observe their old customs, are in a way living witnesses, whose testimony is of value for the knowledge of ancient history, ancient political and social life. The Indian of this country holds so tenaciously to his old customs, he is so devoted to the soil of his birth and that of his ancestors, that only by main force can he be taken from it.

When we remember that since the time of the Conquest all hostilities and wars between the tribes have ceased, we may take it for granted that on the whole, and with few exceptions, the geographical distribution of tribes that exists to-day is the same as at the time of the Conquest; that is to say, that if a certain native language is now spoken in a certain place, we may assume until the contrary is proven that the same language was spoken there at the time of the Conquest. For this reason it is of the greatest importance, not only for the ethnologist, but also for the historian and archeologist, to have an exact knowledge of the geographical distribution of the Indian languages spoken to-day; and for this reason I consider the preparation of a map that will give all the details of this distribution, as one of the labors that should occupy the attention of the International School of Archæology and Ethnology established to-day.

The people who speak the same language do not necessarily form a homogeneous group; there are differences among them which correspond to the diversity of place and condition in which they live or lived, and to their history. Such differences express themselves even in language, and for this reason the study of the dialects is also essential for historical investigation, and will form one of the tasks of the International School. We are grateful to my distinguished colleague, Dr. Boas, who offers his thorough knowledge and experience in this laborious enterprise.

Another help in our investigation that may be of great value are the Indian people of to-day, in so far as they still retain the customs of their forefathers of the time of the Conquest, and in so far as they still retain the traditions, beliefs and tales, adulterated or not, which belonged to the time of paganism. The folk-lore of the Indian tribes of this country will be another and very important part of the labors of our school.

Lastly, we should not forget to study the industries and art of the Indian people, however much they may have been influenced, mixed and changed by the artistic style and the industries that the Spaniards brought with them; there remain in many places the survivals of ancient industry, designs and forms that remind us of ancient styles, that will be of value for purposes of comparison, and that may complete the history of ancient design and help us in its interpretation.

Archeology proper—that is to say, the ethnology of the races and peoples that no longer exist—has the same aims as ethnology, but its methods are much more limited. The archeologist can not collect at will from living people the elements of the language that was spoken, the traditions, the tales, the beliefs and all the evidence of mental development. He must be satisfied with what writers of earlier times—

investigators, historians or general writers —considered worth while to note down. Nor can the archeologist investigate the entire cultural work of a race or people. He can only depend upon the little that good fortune has saved from general destruction, caused by the violence of man, by his negligence and the destructive agencies of time, climate and vegetation. The more is it important for the scientists to collect all the evidence, important as well as that of seeming insignificance, to keep account of the notes that refer to the evidence, to its origin, etc., and to utilize thoroughly the written documents, the descriptions of historians and of the contemporaries of those times, in order to obtain from these documents all possible help for the interpretation of the history of the people.

Useful documents are not lacking in this country—that is, in the region with which historians have particularly occupied themselves—in this valley, in the environment of the capital and among the Tlatepotzcas (people that live beyond the mountains), in Cholula, Tlaxcala and its dependencies, the home of the nation or nations that were leaders in this country. Beyond the limits of the central region, in the provinces, the reports and documents are very scarce. There is no Sahagun for Michoacan and the northeast, nor for the Otomis, near neighbors of the Mexicans of the central region; nor for the gulf coast, nor for the great and rich provinces of the Zapotecas and Mixtecas; and the same is true of the region of the isthmus and the different parts of the people of the Maya family. Regarding all these large provinces we have not more than scattered notes, and few incoherent accounts. Here archeology is the only means that can furnish the data, or any data necessary for the reconstruction of the history of these ancient people and the characteristics of their civilizations.

The International School, in its archeological department, will, in the first place, study the monuments that are in existence and that are accessible, making comparisons and trying to interpret them by means of the old trustworthy accounts, and by means of what may be gleaned from the paintings, the contemporaries of pagan times, or of those made not long after the Conquest.

The Maya monuments are a problem in themselves. As this people had developed the art of writing to a higher degree than any other people on this continent, having originated very nearly a true hieroglyphic writing, and as at the same time they used these characters and signs frequently in their books as well as in their architecture, the Maya monuments should teach us more than those that are found in other parts. Unfortunately, in that region an authoritative interpretation is lacking entirely. Some of the characters have been deciphered, much more remains to be deciphered. The International School will also apply its efforts to this important but difficult branch of the investigation.

The principal work with which the International School will occupy itself will be the search for new material, choosing appropriate places for which the authorities in whose charge the preservation of the monuments of the country is placed, will give the needed authority; discovering, measuring and studying what is found, looking for and bringing together detached pieces, taking photographs and drawings of entire monuments, of special details, opening burials and securing the contents for the museum of the nation.

The school will make efforts to fill in the fragmentary picture of our knowledge in order to give us a better idea of the differ-

ent civilizations that existed in this country—an idea that unfortunately the writers of earlier times did not give us.

At the same time, we must not forget to study the cultural strata to see if there be in some place some means of arriving at a classification or chronological order in which the civilizations followed one another, a history that we have not been able to establish up to this day. All these propositions will require the cooperation of the young who will learn and will in turn become our teachers; who will continue our work, disregarding and boldly setting aside the doubts and hesitancies of the old, and who will not fear to open new paths and with youthful vigor bring to a happy end what we have only been able to begin.

Eduard Seler

THE PLACE OF RESEARCH IN UNDERGRADUATE SCHOOLS[1]

The aim of this academy is the encouragement of research along scientific lines by establishing and maintaining intercourse among those engaged therein, thus stimulating them by a consciousness of companionship in productive intellectual activity. In a small society, embracing in its scope all the sciences, one does not expect in these days of specialization to find others engaged in just the same field of investigation as himself; it is through inspiration rather than information that the investigator profits by these meetings.

It is now hardly necessary to emphasize, even to the non-scientific public, the importance of scientific research; to it mankind owes in a large measure not only his material prosperity, comforts and conveniences, which is sufficiently obvious, but, what is even more important, his intellectual freedom. The changes that have taken place within the last century in our physical environment, with the innumerable applications of science to useful purposes, are no more profound than our intellectual advance and the growing pervasiveness of the scientific spirit in all lines of thought and endeavor for human betterment, physical, social and moral. Our increasingly extensive and effective philanthropies, our giant strides in sanitary administration, and the tottering barriers between the sects of Christendom, are very tangible evidences of the spirit that is not satisfied with precedent or authority, but craves certainty as to the facts, and reasonable explanations for them, as well as the application of all knowledge to the uses of man.

The membership of this academy happily includes scientific workers in many fields. Some apply the results of research to the needs of the state in developing its resources and protecting its citizens against the injuries inflicted by ignorance and fraud; others make science the servant of industry and commerce; others, again, are active in applying it to the preserving and restoring of the health of our bodies. A large part of our membership, however, is made up of those whose chief occupation is teaching.

While it has not always been the case, it is probably true at present that the most valuable contributions to human knowledge are made by those engaged in this profession of teaching. This is not surprising, for the nature of his calling demands that the teacher to be effective must ever continue to be a student, and the thorough study of any subject reveals the limits of our knowledge in that field and tempts the man of active intellect to the task of extending those boundaries; there is surely no keener pleasure than the learning by one's own search some truth, however inconspicuous, not previously known.

[1] Address of the president of the Indiana Academy of Science, November 25, 1910.

Not only does teaching tend to stimulate research, it also gives it balance by preventing the too exclusive attention to the comparatively narrow field under intensive cultivation; the necessity of presenting well-ordered information covering the broader subject, and the oral statement of original theories and conclusions, must have a broadening and clarifying influence on the intellectual activity of the investigator.

As teaching is a help to research, still more is research a vitalizer of teaching, particularly of the teaching appropriate for graduate students; indeed, the work of research is at least as important as that of instruction where advanced students are concerned, and the university should be a source of new knowledge, where those desiring to devote themselves to the same high quest may be stimulated by the example and companionship of productive scholars.

The leading European nations have apparently realized more clearly than we the value of scientific research, and have provided more adequate rewards and more favorable environment for the investigator, with the result that the ratio of intellectual to material prosperity is higher there than here. Within the past generation, however, we have become more awake to these matters, and have determined in our strenuous way to make research "hum." The awakening has unquestionably been beneficial on the whole, but we have, it seems to me, failed to grasp certain fundamental distinctions between the needs of graduate and of undergraduate students; the hum of research has been allowed to drown the cries of the injured in many an undergraduate school, where teaching is sacrificed to research, and where too early specialization is encouraged and even forced upon the student.

We are not as yet in this country producing our proper share of scholars of the first rank. The reasons for this are many, including hasty preparation, premature specialization, insufficient rewards, and unfavorable environment.

As to preparation, those of us who contemplate academic careers are usually unwilling to invest sufficient capital of time and money; we expect to complete our scholastic education, if uninterrupted, at about twenty-five years of age and then enter upon an active career in which there is little time or opportunity for research or even very serious or intensive study, for the sake of the immediate pecuniary reward; in Europe, several more years are spent in subordinate positions as investigators, on a semi-independent basis both scholastically and financially. The European makes a larger investment and reaps a larger ultimate reward, not only in money, but still more in the consideration accorded to intellectual eminence.

Concerning too early specialization and its shallow results, I shall speak later; let it suffice here to say that, for example, he is a poor chemist who is only a chemist.

The rewards at present offered for pure scientific work in this country are insufficient to attract the most vigorous, capable and ambitious men; not only, nor chiefly, are the financial returns here less than in Europe in spite of our higher cost of living, but the public respect for intellectual distinction is far inferior in this country, on account of our commercialism and our acceptance of wealth as our standard evidence of merit.

The environment, too, is less favorable to the highest scientific work in that the numbers of those engaged therein are so few, and the national characteristic of haste rather than thoroughness pervades our activity. The value of real scientific

attainment is still but dimly recognized by the industrial world; chemists are employed like clerks, without graduate training, and work like day-laborers, but for less pay, at routine analysis, with neither the training nor the opportunity to attack the larger problems in a fundamental scientific way. Such chemists are not on the same plane as the higher chemists in the German manufacturing industries, who have supervision of the works as well as the laboratories. One result of this primitive lack of demand for highly trained men is the small number pursuing research in our universities, so that even our best qualified professors have a mere handful of research students, and many of these can be induced to continue their higher education only by fellowships sufficient to pay their living expenses; if such aids were discontinued the numbers of our graduate students would be even less favorably impressive than at present, though in time the larger investment of those remaining would show in the larger salaries that would have to be paid to the men more difficult to find. Leading German professors attract large numbers of well-trained students, making possible their remarkable productiveness.

The keener competition in all walks of life in Europe has some advantages—only the thoroughly trained can hope for success, hence their desire for the most complete preparation. We consider ourselves fortunate in being protected against foreign competition, and in being able in consequence to make an equally good living with less effort; but are we really to be congratulated on our lower intellectual standard of living and on our dependence upon imported thought and intellectual products?

Another result of the limited scale on which scientific investigation is being conducted, and our "high standard of living," is that it is not worth while for manufacturers here to supply refined or unusual scientific material; if an American investigator needs, for instance, a special chemical, he must wait two or three months for its importation, while his European colleague could obtain the same in as many days or even hours, or, if manufactured here, two or three times the foreign price must be paid. The American artisan is more highly paid than his European brother, but not so the more eminent intellectual worker. Does this mean that we are not civilized enough to appreciate any but material products?

Naturally the realization of the value of intellectual things is found first among those engaged in the work of education, and our larger and better endowed colleges have within the last half century shown their appreciation of productive scholarship and developed graduate schools to compare more favorably with the European universities, so that it is no longer necessary for our students to go abroad for the inspiration of working with men who are extending the boundaries of human knowledge. Once started, the fascination of research insures its continuance as long as a favorable environment exists.

The institutions that have been able by their large means to adequately maintain graduate departments have been so amply rewarded by their enhanced prestige, that many others, without sufficient means, have attempted to do the same thing; the result has been impaired undergraduate instruction with a more or less successful imitation of graduate work.

A graduate school should recognize as its most important possession the productive scholarship of its faculty, making the institution a center of new knowledge, and all other matters should be arranged with

a view to encourage and stimulate scientific investigation. A very moderate amount of class instruction and other duties should be demanded of the members of the faculty, and students should be sufficiently mature and earnest to work without compulsion and with little direction under the guidance and inspiration of the men who are doing real original work.

The case of the undergraduate school is fundamentally different. I believe that the prominence given to research in many undergraduate schools is a positive injury to the student; his instructors are chosen on account of their ability or promise as investigators instead of their qualifications as teachers, and even the student himself is encouraged or forced to undertake so-called research with entirely inadequate training, both as regards breadth and depth. The undergraduate years should be employed in acquiring a well-balanced knowledge of the fundamentals of the student's specialty, and an acquaintance with the elements of many allied subjects, together with a working grasp of such tools as modern languages, to make professional literature accessible at first hand, mathematics, for the mental training and grasp of the quantitative and statistical treatment of all studies, and every undergraduate student should give such attention to history, literature, and economics as to make him an intelligent citizen and man of culture.

Only when this has been in a measure accomplished—and in looking back to our own college days we realize that a mere beginning had been made when we graduated—is the student in a position to profitably undertake research with a proper appreciation of what he is doing and how to do it, so that it is really research for him and he is not merely a pair of hands under the direction of another's brain. The effectiveness of a scientific investigator is generally proportional to the thoroughness of his preparation; too many attempt to discover new truths before they have grasped those already discovered by others.

In many institutions one of the requirements for graduation is called a thesis, and such a tradition is difficult to dislodge, but I think the name is unfortunately pretentious and is apt to mislead the student into thinking himself more advanced than the facts justify; it savors of the same spirit that induces the high school to ape the college in so many ways, in its pernicious fraternities and even in having a "baccalaureate" service—doubtless to celebrate the fact that the boys about to graduate are still unmarried; such unwholesome symptoms are usually most conspicuous in institutions with the least merit. The preparation of an undergraduate thesis may be a valuable item in the course if it is not so administered as to waste the student's time, narrow his mind and swell his head. I believe its most valuable feature is its compelling him to go to original sources for information, namely, library work. Too many students graduate without this experience and with a knowledge of books limited to the prescribed texts employed in the course. To choose a subject of real interest to the student and of suitably narrow scope, and to find out by systematic search in the scientific journals all that is known about it, and then to write an essay in which the information is carefully arranged and well presented, is a task well worth the performance.

It is entirely laudable for every institution to aim at ever higher goals; not, however, by raising the entrance requirements beyond the reach of its natural constituent, even at the dictation of some self-appointed board demanding uniformity under diverse conditions, and not by

changing the object of its training—there would not be necessarily any gain to the community at large should a school of pharmacy gradually become a theological seminary or even a medical college; a school of pharmacy is just as necessary as either of the others.

It is perfectly natural for any teacher or group of teachers to aspire to more advanced grades of work, but this should not be undertaken unless the more elementary and fundamental work is adequately cared for.

We are suffering from too much ambition of this kind; too many trade schools attempt to be colleges, and too many colleges attempt to be universities, at the expense of their efficiency in their original equally important field. Let us imagine that every grade school gradually introduced more and more work of the high school, that every high school gradually became a college, and that every college gave more and more of its energies to graduate students! Or let us imagine that every institution giving grammar school instruction attempted also to provide training through the high school, college and university curriculum! What a ridiculous and inefficient educational system must result. Roughly speaking, for every thousand grade schools we need about a hundred high schools, ten colleges and technical schools, and one graduate university.

Fortunately, there is a supervision that prevents the transformation of grade schools into high schools, and separates the work of the two as soon as numbers of pupils justify the step; it is a pity that there is no authority with power to insure similar efficiency on the part of undergraduate and graduate colleges and universities.

We are failing to appreciate the distinction between undergraduate and graduate work. In most ways there is little more in common between these than between that of the high school and of the college, and the university is injured in the attempt to make it a small part of a large college. Efforts have been made in this country to have universities unhampered by undergraduate departments; unfortunately, however, the country has declared itself not yet ready for such a logical and much-to-be-desired arrangement.

The chief function of the undergraduate school is to give instruction in such a way as to insure mental development. For those few who are to proceed to graduate work, the soundness, breadth and depth of the foundation will largely determine the safety and usefulness of the superstructure of specialization to be erected later. The first qualification for membership in the teaching staff of an undergraduate school should be teaching ability together with a thorough knowledge of the subject to be taught.

This teaching ability is largely a natural gift, and if of a high order is not common. Let us recognize it, use it, and reward it as an asset of the highest value. It can not be created by the study of pedagogy any more than logical thinking by the study of logic; it is founded on the intuition of sympathy. Teaching is the keenest pleasure to some, the hardest drudgery to others; the student readily distinguishes the two. I would not, however, imply that even the best teacher can work effectively with the undergraduate who struggles to escape education or who is unwilling to make any effort for it because his interests are now intellectual; such students have no proper place in an institution of higher learning, and we expend much too large a part of our energy in forcing such material through to graduation. The fashionableness of going to college is by no means an unmixed blessing. Why does not some en-

terprising individual start a college with luxurious dormitories and means of recreation and dissipation, where work shall be optional and house-parties continuous? Enormous fees could be charged, professional athletes employed, a suitable degree conferred after four years, and the working colleges protected from young men not desiring to be educated.

The chief function of an undergraduate institution is instruction, and its faculty should be chosen with this in view. Every such teacher, however, to attain his highest efficiency, should engage in some kind of research, that is, getting new information at first hand. This can not fail to have a vitalizing effect on his teaching, keeping clear the distinction between fact and theory, and maintaining his instruction abreast of the times.

There is questioning of the value of much that is published as scientific research, and it is easy to criticize the spirit that piles up undigested data or adds to the number of chemical compounds for the sake of having something to publish; it is impossible to say, however, that any such information is and will continue to be valueless. I am less interested in discrediting such work because it now receives higher recognition from the undiscriminating in the educational world than it deserves, than I am in asking for recognition for a kind of labor, just as truly research, that now receives too scant credit from the public and from those responsible for the distribution of rewards to college teachers. I refer to what may be called pedagogical research—the labor involved in improving and constantly rejuvenating the instructional work. Any course that remains unchanged for many years is probably in need of repairs, but desirable changes usually involve much labor on the part of the instructor. The teacher whose heart is in his teaching and who carries the usual overload of duties is likely to be kept busy at just such work, and have no time left for the more conventional kinds of research; but his students will profit by his labors. The administrative officer who directly or indirectly puts pressure upon a college teacher to neglect his teaching is seriously injuring the college; yet this is by no means uncommon, intentionally or otherwise.

Research, of whatever kind, is largely a matter of inspiration, and can not be forced; as profitably might a poet be urged to become a painter as a scholar be pressed to undertake investigations foreign to his inspiration. Left to himself, the investigator will do what he is most interested in and therefore likely to do most fruitfully; to attempt to force a teacher whose instincts are for pedagogical research to other kinds of investigation is likely to spoil a good teacher and make a mediocre investigator. The method of forcing commonly practised is the indirect but very effectual one of recognition of published research by promotion and increased remuneration, while devotion to teaching and pedagogical research receive no such rewards.

Let us recall our own undergraduate experiences. Did we not in many cases get most stimulation and make most progress under teachers unknown in the professional journals? It is to be expected, indeed, that the teacher whose chief pride and interest are in his teaching, and whose chief reward is the advancement of his students, should be of more real value to those students than the investigator whose hours of reflection are devoted to the problems of his research, and to whom the instruction of classes is incidental, if not, as in many cases, an unwelcome interruption. Gifts of an equally high order for instruction

and for investigation are not usually found in the same individual; let each give his main effort to what he can do best; let the investigator work with mature students and the teacher with the immature, and let the distributors of rewards make no invidious distinctions in the recognition of the two equally necessary and meritorious services.

It is eminently desirable that a teacher should be also an investigator; in every faculty, however, some members have more pronounced ability than others in this direction, and it is proper that such should receive special consideration as to other demands upon their time and attention in order to enhance their productiveness by favorable conditions. To the others, whose bent is less marked in the direction of research, should be assigned the duties of administration and the committee work, with, if necessary, the high school commencement addresses. Neither should the more general business of the college be regarded as of any less value or importance than research, or less worthy of reward. To be sure, it has not the same advertising value, but an institution of learning should be above adopting the motto "quick returns and small profits." The most enduring good accrues to the students, and therefore to the college, from inspired teaching and wise and careful administration.

It is certainly the part of wisdom to provide as favorable conditions as circumstances will permit for the encouragement of research. Several factors more or less obvious enter into this favorable environment and influence the productiveness of the investigator, but the real determining factor is in the man himself; he must have ideas, enthusiasm and industry; he may even be a crank; he must have an accurate memory to retain the results of extensive reading, and as much as any one can profit by good health, to withstand the strain of concentrated and continuous effort; he must be absolutely honest with himself and the professional world. If he has the necessary qualities it is very unfortunate if his circumstances do not permit their most fruitful activity; if he has not, let him serve his institution in other ways for which he is better fitted—ways of equal importance. Few men can spend several hours daily with classes, several more in administrative work, one or two more in committees, and have any vitality left either for research or professional growth.

The greatest need of most successful college teachers is more time to think. The evil effects of the prevalent rush become apparent only very slowly—in the course of years—in a gradually failing effectiveness for lack of mental nourishment. No one can use a few minutes now and then, snatched from the more urgent duties of the moment, to do or even think real research; ideas do not come on demand, interruptions are often fatal to inspiration, experimental work often must be continuous to lead to results; investigation that is worth while is not a routine operation to be started and stopped by a gong; there must be mental growth as a background. It would probably be economical in the long run if the real teacher-investigator could be assured of uninterrupted privacy for half of every day.

In addition to time for thought, reading, experimentation and writing, the teacher of science needs space and material equipment. There is a temptation to spend money most freely in ways that lead to the most tangible results, and would-be benefactors may cause serious embarrassment by providing buildings without equipment or endowment; blessed be the liberal contributors to the "gen-

eral fund," meaning equipment and, most important of all, competent men.

In the providing of suitable buildings with limited means, circumstances must decide how much can be devoted to what may be called luxuries and quality as against necessities and quantity; it is certainly desirable to have buildings as beautiful as possible, but not at the expense of adequate size and equipment.

Books are too often a crying need; they cost so much and they show so little; and yet without them research is impossible. The most serious lack is usually that of complete files of the scientific journals, which can *never* be purchased on a non-accumulating allowance of a hundred dollars a year. The value of the library habit to the student can hardly be overestimated, but to develop this plenty of books and an attractive place for reading them are almost indispensable. How welcome to the business manager of many a college in straitened circumstances would be the professor who "did not read books but wrote them."

Turning now to the question of assistance, from the purely business standpoint, a man should not be required to do what a cheaper man can do as well; the problem, however, is by no means solved by so stating it. The profitable use of assistants is a far from simple matter; their duties should be so assigned and supervised that their time may be spent to the advantage of the department and also to their own obvious profit. The men available have usually recently graduated and should realize that the salary is not the chief reward for their services, but that the time spent as an assistant in a well-conducted department is valuable as a period of education and necessarily precedes any more advanced position in the college or university world. The assistant should welcome all such experience, even if some drudgery is included, as gives him an insight into the teaching of his subject and the management of departmental business, such as the handling and ordering of supplies, the administration of classes, and the keeping of systematic records. To really review and extend his knowledge of the fundamentals of his subject so as to meet the needs of students entitled to his help is no slight task, but the assistant should use his utmost efforts towards progress in more advanced study and in research if his preparation is adequate. The assistant who shows the right qualities will not long fail to receive recognition and promotion; in the teacher's profession "everything comes to him as can wait" as far as he has the qualifications. Given the natural ability, industry and personality, thorough preparation will compel success; an assistant's position in a large and efficient department in association with successful men is better preparation for ultimate success in college or university work than the better paid positions in high schools open to men of equal training.

Those having charge of assistants should see to it that there is opportunity and encouragement for proper growth. It is through such assistants that the older teachers may hope to accomplish research, in doing which both are equally benefited. It is, however, something of a deception to call such assistants' positions "fellowships" if the duties of the department occupy any considerable part of the time.

It is certainly desirable that the more experienced teacher should delegate to assistants such of his work as can be properly done by them; it is very undesirable that he should cease to have direct and constant contact with the work of students; the direction and development of courses should remain actually in his

hands and the work of assistants be under constant scrutiny. When it becomes impossible for a course to continue actually under the direct management of a senior instructor it should be placed in charge of a qualified associate whose responsibility will be the incentive for his best work; the plan followed in some universities of having courses nominally in the hands of those for whom it is impossible to actually direct the work, which is really done by junior men, is essentially unfair to the latter, in withholding from them the credit to which they are entitled, not conducive to the best results in that it fails to provide the incentive for devoted effort on the part of those actually planning and administering the work, and an imposition on the college and the public, who believe the courses to be really administered by the more widely known teacher. Many a student has been disappointed in finding that he has little or no contact with the man advertised as having the work in charge.

In growing institutions it is the usual experience of the teacher that other duties encroach more and more upon his instruction and research, the latter being first sacrificed. Some of these are indispensable, such as the keeping of accurate records of students' work, and as institution and department grow there is some unavoidable increase in the machinery for handling students; the red tape and machinery should be recognized as a necessary evil—a means not an end—and kept at a minimum; if the choice were imposed between good teaching with no records and good records with no teaching, the election would be simple. There may be a conflict of opinion on this subject, however, between the engineer of the beautiful machine and the poor laborer whose energies are consumed in feeding it with reports. I believe that we devote too large a part of our attention to the lazy and incompetent, to the detriment of the more energetic and able students, on account of the struggle for the prestige accorded to numbers, which we may also charge with the use of colleges as lounging places for the sport and the intellectual dead-beat. It is surely unfortunate if a teacher has to spend his time in keeping elaborate records of and forcing the loafers instead of stimulating and satisfying the gifted.

The question of salary has an intimate bearing upon the efficiency of college teachers, and it is generally admitted that they are underpaid. The cost of living varies so widely in different college towns that a salary adequate in one would be entirely insufficient in another, so that it is impossible to name a suitable salary. As a general principle, however, it may be accepted that the remuneration should be enough to attract men of energy and ability and make possible their best work. It is not desirable that teachers should vie with the commercial classes in display or in expensive amusements, and men of intellectual strength would not wish to; it is proper that they should receive enough to permit comfort without anxiety, membership in scientific societies and the opportunity to attend their meetings, books and other professional tools, and also travel, society, and the enjoyment of music and art, for the sake of their own broad development and consequent influence in society as well as with their students. The man who never sees anything but his home and his place of business is certain to be narrow. Many young men ruin their professional prospects by marrying on a very small income even before their education is complete; it is no evidence of a lack of sentiment for a man to postpone marriage until he is in a position to properly main-

tain a family. Further, it is surely the cause or the result of second-rate qualifications as a college teacher to attempt to carry on another business with no bearing upon his professional pursuits for the sake of the increased income. Scarcely less valuable is the semi-professional routine of tutoring, commercial analysis, and even the preparation of uninspired text-books, for the same reason. These things do not give the best preparation for and naturally do not lead to the highest university positions, though they do bring immediate financial reward; better far devote the time to some research if there is any in the teacher, and qualify for advancement in the college or university world. In education as in business, both the teacher and the institution may expect to get what has been paid for; if the teacher gives less than his best efforts he may look for less than a full reward, and the institution that seeks bargains in teachers will probably get something cheap—and nasty; if first-rate results are to be achieved the price of first-rate ability must be paid, allowing for a long and expensive preparation.

The bearing of this upon the question of research is evident; to cultivate the vitality of the intellect it must be free—free from anxieties as to the necessities of life, free to proceed in broad and deep channels, with all the incentives of intercourse with things intellectual and esthetic.

The story is told of a college teacher, who was conspicuous at prayer meetings, that it was his custom in closing a lengthy petition covering a large amount of detail to say, "And now, O Lord, to recapitulate," and so on.

Permit me, then, in conclusion to summarize the points I have tried to present. In undergraduate schools research has a very important place as a stimulator and vitalizer of the teaching; it is, however, a secondary calling and should not be allowed to interfere with the main function of the undergraduate teacher, namely, instruction. The selection of men for such positions should be based primarily on their qualifications as teachers, and research should not be undertaken until a broad and deep foundation has been laid. The value of research, however, makes it most important that men capable of doing it should be helped in their efforts by the most favorable environment possible.

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A PLEA FOR ORGANIZED RESEARCH IN THE TROPICS

As science progresses we begin to look for new fields of research, for an increased sphere of investigation, for a greater and more varied amount of facts upon which to base our generalizations and our conclusions. As modern development generally becomes more pronounced we begin to reach out for opportunities in new regions, in those parts of the world where civilization has not yet gained a final foothold. To-day the tropical countries are still comparatively unknown, forming a terra incognita which contains many secrets for the explorer, many problems to be solved by the scientist, many riches to be gathered by the pioneers, always ready to exploit the resources of new regions.

With the striking diversity in their natural productions, their variety of geological structure, and their extreme conditions of climate, the tropics offer, in most branches of natural science, exceptional opportunities and wide fields for investigation and research.

Scientific research in the tropics has been carried on in a more or less perfunctory manner. Tropical research generally has not been conducted in a really scientific way. There is no organized and systematic investigation of tropical conditions, with the exception of a few years' work in this direction in Java and the Philippines.

I hasten to explain the above statements which at first sight may appear too sweeping and too severe. It is true that by individual and public effort, in the eastern tropics, in India, Ceylon, Malaya, Java and the Philippines a large amount of scientific research on tropical subjects has been accomplished from time to time. Vast quantities of valuable observation have been accumulated, but we still lack scientific data from many other parts, without which we can not arrive at definite conclusions. It is equally true that many individual scientists and scientific explorations have penetrated the swampy forests of the Amazon and the Orinoco, have marched over the pampas of Brazil and the llanos of Peru, have paddled up the affluents of Magdalena and Marañon rivers, climbed the snowy peaks of the Andes under a tropical sun, dwelt on the fever-infested sands of the Mosquito coast or sweltered in the dampness on the slopes of the Central American volcanoes, but all this work has been accomplished without a comprehensive plan or a definite purpose in view as to a final understanding of the conditions of the tropics. This pioneer work is most valuable, it has shown us what a marvelously rich field for research is to be found in the tropics.

The old European nations with tropical dependencies realized long ago that the successful opening up of their colonies depended on a proper knowledge of their resources. From the time of Linnæus, who sent many of his pupils to tropical countries, to that of the Honorable East India Company, from the time of Captain Cook's first voyage, when Banks and Solander gathered such valuable data, up to the present day the collections from the tropics have been mainly of an economic nature. These collections have been stored and studied in European and American scientific institutions, generally by scientific men who have not themselves had the opportunity of travelling in the tropics. Where such studies have been made on living specimens the latter have been kept under artificial conditions, which seldom if ever give a true imitation of the real natural surroundings such as they exist in the tropics.

The most important among such institutions in Europe is Kew, with its gardens, hothouses, museums and herbarium. By being the central place of tropical botanical research for the British colonies, as well as a school of tropical horticulture, which has produced a great number of scientific men for Great Britain's tropical dependencies, Kew has rendered tropical science invaluable service.

The Imperial Institute in London, in later years, has commenced to investigate colonial products more closely than was possible at Kew, and the brief but useful work of the Liverpool Institute for commercial research in the tropics indicated the lines upon which tropical investigation ought to be conducted. The Liverpool School of Tropical Medicine through the investigations of Ross and others deserves the highest praise.

We find in India numerous scientific institutions for tropical research, and in the British colonies generally the botanical and acclimatization gardens have become features of the greatest importance. Of British tropical gardens in the East, those in Singapore, Peradeniya, Calcutta and Kamerunga are especially noteworthy for their services to botanical science in general and to tropical agriculture in particular. The German, Brandis, organized Indian forestry on a scientific basis, which is not surpassed even by the work of Pinchot in this country, and the investigations in recent years at the Dehra Dun Forest Research Institute are unique in their thoroughness and value. It took an American to establish Indian agricultural research on a modern footing, and the Agricultural Research Institute at Pusa is now recognized as one of the leading institutions in the east.

The small acclimatization gardens in Brisbane, Port Darwin, Perak and Bangalore have been very useful in their way.

Holland found that the material progress of its colonies depended on the scientific development of agriculture, forestry, mining and other industries. With characteristic

thoroughness the Dutch set about the study of their colonial resources. The botanic garden at Buitenzorg with its many accessory institutions remains easily the leading one in the world, and the monumental work of Treub, whose recent death is a great loss, as an organizer and scientist can not be overestimated. His agricultural department of the Dutch East Indies was probably more efficient than any similar institution in the entire world.

The new development of the black continent has led to increased activity in the investigation of its scientific problems. Many new institutions of research have been founded, both in British, German, French, Belgian and Portuguese colonies in tropical Africa.

While the eastern tropics and their resources are comparatively well known, we have a very scant knowledge of the tropics of the western hemisphere.

Besides the few scientific institutions in the British and Dutch West Indies, and in Brazil, there are no botanical gardens, no agricultural experiment stations, no meteorological observatories, no medical research institutes, no zoological laboratories in the American tropics. In all the large territory of Central America, in Colombia, Venezuela, Ecuador and Peru there is absolutely nothing being done in scientific research of the tropics.

The United States of America have in recent years acquired valuable tropical dependencies, and in Porto Rico, Hawaii and the Philippines, notably in the last, scientific investigation is receiving due attention, in accordance with the requirements for scientific knowledge characteristic of present-day America.

The people of this country are, however, interested also in other parts of the American tropics, even if these are not political dependencies of the United States. It is sufficient to recall the fact that over a billion dollars of American money are invested in the tropics, in order to realize this. The American people investing in the tropical industries of the equatorial regions of this hemisphere have not had the assistance of science in making their investments secure and profitable. How different are conditions in Great Britain!

America has been so preoccupied with the development of its own enormous resources that the tropical parts of this hemisphere have been left to work out their own destiny unaided.

The Monroe Doctrine as an expression of the homogeneity of all interests affecting America should cease to be a political theory only, and should be brought down to commercial, industrial, literary and scientific reciprocity between the American countries. Trade relations are becoming more intimate. It is time that scientific relations become more frequent.

Tropical America is to-day more European than American. For centuries maritime Europe has been trading with the American tropics, supplying immense amounts of capital for the development of their vast resources, and converting these countries into commercial, if not political, dependencies.

To this day Europe has done more for the scientific exploration of tropical America than American scientists. There is, fortunately, no Monroe Doctrine as regards American science. But thoughtful Americans can not but lament their country's neglect of the great opportunities for contributing to the progress of civilization in tropical America.

Every country in the world needs the products of the tropics. Those that have not tropical dependencies of their own must acquire such products from other countries. The requirements of a prosperous nation of 90,000,000 of consumers have created a great market for tropical products in the United States. Humanity in general derives to-day many products from tropical countries, which have become articles of daily need where a century ago they were luxuries.

Tropical America, with its vast areas of fertile land, its abundant rainfall and perfect climate, and its proximity to the world's largest market, is capable of supplying all the products of the tropics in enormous quantities.

To be able to take advantage of these conditions, it is of the greatest practical importance that we arrive at a better and proper understanding of tropical countries.

The aid of science is necessary to make the tropics habitable and productive. Academic as well as applied science has in the tropics an open field. But we need organization and systematic work, instead of haphazard skimming of the surface of the scientific treasures of the tropics.

Where the problems are legion, and where the material is as abundant, and the opportunities as frequent as they are in the tropics, it is a general failing of the scientific worker that he becomes interested in too many features to be able to do his best. This must be avoided.

With the exception of the botanic gardens at Buitenzorg there are no scientific institutions in the tropics adequately equipped or properly manned. The usual small institution with a staff of two or three scientific men, often hampered by demands on their time for work in applied science, can accomplish but little. The need of a large institution for the investigation of tropical America becomes apparent when we take into consideration a few of the scientific and practical problems, which in thousands are waiting to be solved in the tropics.

The riches of tropical countries were the incentive which led to the great discoveries of unknown lands. They furnished the principal motive for the travels and discoveries of Columbus, of Balboa, of Vasco di Gama, of Dampier and Captain Cook, of Bougainville. Humboldt made his most acute observations while following the Cordillera through the American tropics. Darwin and Wallace collected their most important evidence in tropical countries for the theory of natural selection. Huxley, and Agassiz, father and son, acknowledged the value of their tropical journeys for their work.

The educational value to the young naturalist of tropical travel is now well recognized. It is to be hoped that an American institution for tropical research will make it possible for every young scientist of this great country to study for some time at least the peculiar conditions of the tropics and to contribute to the knowledge of tropical phenomena, by travel and investigation.

The conditions of life in the tropics as far as prevailing external conditions are concerned, are favorable to the development of a multitude of individuals, and consequently there is such a severe struggle for existence as is entirely unknown in more temperate climates. The many problems arising from this fact can not be studied to better advantage elsewhere.

There is no better place for a study of plant geographical problems than in the undisturbed regions of the tropics.

Systematic observations of the phenological stages and similar features of tropical plants in their natural surroundings have yet to be undertaken.

Very little work on the ecology of tropical plants has so far been done. This should be undertaken in the tropics. The hothouse method of studying plant phenomena is not reliable. Instead of showing the development of the tropical plant in its natural surroundings, it rather indicates the adaptability of the plant to unusual conditions and the possibility of acclimatization. The plants can not be placed under natural conditions in artificial temperatures.

The plant pathologists will find the tropics teeming with lower forms of life preying upon vegetation, and work on these lines is in great demand and of immense practical value.

The relation of plant life to geological conditions, the work of plants in changing the topography of the earth's surface, are equally interesting to the botanist and the geologist, and very little is so far known upon these questions from the tropics.

While in cold regions there is a retardation of development of plant life caused by low temperatures, in the tropics the same effect is caused by variation in moisture. The latter factor controls plant life in tropical regions, while in temperate portions of the earth heat is the principal factor influencing vegetable phenomena. Thus the dry season in the tropics corresponds to the winter in other parts; it is the time of rest and death. These relations are as yet but little understood in the tropics.

While light and the incident sunshine fur-

nish the mechanical or molecular energy at the disposition of the plant, they are the least understood of the climatic elements. In the tropics the light conditions are very intense and for this reason actinometric studies are especially necessary in tropical countries.

As for the chemical intensity of light, such comparative work as that of Roscoe and Thorpe in England, Portugal and Brazil opens up most interesting vistas of research.

While we have valuable results from temperate climates in regard to the relation of plants to soil moisture, evaporation and associated phenomena, we know practically nothing about these conditions in the tropics.

We know that in the tropics the average annual temperature differs but little, while the quantity of precipitation differs largely. The latter feature is of greater importance and needs therefore special study. We have a large amount of scattered data and much generalization, but practically nothing of definite scientific or practical value.

Tropical soils are as yet very little studied, except in a few localities, as in the West Indies, British Guiana and Java. The rapid decomposition of rock caused by the combination of abundant moisture and heat furnishes new layers of soil as well as a fascinating subject of study for the geologist and the chemist.

The numerous vegetable products of the American tropics are as yet very little known from a scientific point of view. There are scores of tan barks, dozens of oil-producing plants. New rubber plants are found frequently in the neotropical regions. New and old tropical fruits invite study, and economic plants generally occur in abundance.

When we consider that tropical America has given mankind more economic plants than any other part of the world, it seems strange that, after all, tropical America is less known to-day than any other region of the earth. We may only mention corn, potatoes, cacao, tobacco, rubber, sisal hemp, vanilla and probably bananas among the important vegetable products of the western hemisphere.

There is an open and very profitable field for the plant breeder in improving tropical products.

The tropics are inhabited by peculiar and interesting races of mankind, and traces of ancient civilizations are now obliterated by a luxuriant forest vegetation, which clothes the tropical lands from the level of the sea to the summits of the loftiest mountains. The anthropologist and the ethnologist find in tropical America some of the most complicated and interesting problems of research.

It is in the tropics where the principal volcanic belts encircle the globe, and with their variety of geological structure, their frequent earthquakes, their coral formations bathed by the tepid waters of the great tropical oceans, the tropics of America offer unequaled opportunities for geological studies.

The violent electric discharges in the tropics produce atmospheric nitrogen, which probably is carried by the rain water into the soil, and thus contributes to and probably explains some of the fertility of the tropical soils. Our knowledge in this regard is very limited.

Where the tropics teem with vegetable products of the most striking diversity, animal life also is most abundant and of great variety. Tropical zoology is so far only touched on the surface, and especially are the lower forms of animal life in the equatorial zone known only slightly.

The pathogenic bacteria have only in a few instances been investigated and a large field is here open. There has been much progress in tropical medicine during late years, but while we know the elements of this science there is still much to learn, many tropical diseases to study and many remedies to discover.

Modern science has demonstrated that life in the tropics is possible for white man, and if ordinary precautions are taken he is as safe there as in any other place. Tropical exploration has craved its dues in form of many martyrs to science, but with modern appliances and present-day knowledge there is no need of privations and exposure during tropical travels.

In this regard it is of special importance that systematic research in the tropics be

inaugurated, so that scientific workers may receive proper instructions and advice as to methods and conditions of life and travel. Instead of gathering his own experience in this regard he should be able to rely on that of others, and without waste of time devote himself to his scientific work. Every scientific investigator in the tropics knows that the information he received when he prepared for his journey of exploration into the primeval forest was practically valueless, and he had to learn for himself, often at considerable expense, loss of time and not infrequently of health.

An international, a Pan-American institution for the scientific study of the conditions of tropical America is needed. American scientists should take the lead and invite their colleagues of the Latin-American republics to join them in a systematic endeavor to study the tropics of this hemisphere, its natural riches and its diversified conditions. Such a course will be as important for the preservation of peace, for the mutual understanding between the peoples of the Americas, and for the progress of these countries as commercial treaties or diplomatic conventions.

I do not propose here to enter into details in regard to the organization of a Pan-American scientific institution for the systematic study of the American tropics. I do believe that the time is ripe for such an undertaking, and I have reason to think that if a suitable plan is defined and proposed it will meet with the ready response and approval of the public and the governments of all the American republics.

PEHR OLSSON-SEFFER
TEZONAPA BOTANICAL STATION,
MEXICO, D. F.,
December 20, 1910

OCTAVE CHANUTE[1]

OCTAVE CHANUTE was born in Paris, France, February 18, 1832. He was brought to this country in childhood, was educated chiefly in New York City and began the practise of his profession as civil engineer at an early age.

After having done efficient work in railway construction in New York, Indiana and Illinois, he became in 1863 chief engineer of maintenance of way and construction of the reorganized Chicago and Alton Railroad, remaining upon that line until 1867.

During this connection, having been invited to submit a design for the proposed Union Stock Yards of Chicago, his plan was selected in competition with a number of others and he built these yards as chief engineer. He was also awarded a premium for a competitive design for a bridge across the Missouri River at St. Charles, Mo. In 1867 Mr. Chanute went to Kansas City, Mo., as chief engineer of the bridge across the Missouri River at that point. This was the pioneer bridge across the Missouri River, and as the river pilots and riparian dwellers had given this stream a bad reputation, the successful completion of this bridge across it in 1868 attracted great attention and interest.

Later Mr. Chanute successively became chief engineer of the Kansas City, Fort Scott and Gulf, the Kansas City and Santa Fe, the Atchison and Nebraska, and the Leavenworth, Lawrence and Galveston railroads.

From 1873 to 1883 he was in the service of the Erie Railway as chief engineer. During this connection he readjusted the motive power of the road and lessened the grades so that the through freight trains, which averaged eighteen cars when he first became connected with the line, had grown to thirty-five cars when he closed his connection with the road in 1883, when he removed from New York to Kansas City, in order to look after his personal interests, and to open an office as consulting engineer.

In this latter capacity he took charge of the construction of the iron bridges during the building of the Chicago, Burlington & Northern Railroad between Chicago and St. Paul in 1885, and of those of the extension of the Atchison, Topeka & Santa Fe Railroad, from Kansas City to Chicago, in 1887 and 1888; the latter involving, besides a number of minor streams, the Missouri River bridge at Sibley

[1] Presented to Section D, American Association for the Advancement of Science, Minneapolis, December 30, 1910.

and the Mississippi River bridge at Fort Madison.

In 1889 Mr. Chanute removed his office to Chicago, where he engaged in promoting the preservation of timber against decay, by chemical methods.

Mr. Chanute became a member of the American Society of Civil Engineers, February 19, 1868, and has contributed a goodly number of papers to its *Transactions*. In 1891 he was president of that society; in 1901 he was president of the Western Society of Civil Engineers, and was honorary member of similar societies in England, France and Chile.

In October, 1891, there appeared in *The Railroad and Engineering Journal*, of New York, the first of a series of articles on "Progress in Flying Machines," written by Mr. Chanute. The series was extended in the next two or three years, and in 1894 was published in book form under the above title. It is a volume of over three hundred pages and it tells both of failure and progress. The author, bringing all of his resources as a skilled engineer to bear upon the unsuccessful experiments, analyzed all of the more important work done by scores of men and tried to point out, as much as might be, the causes of failure.

In the preface to the book it is stated that one of the writer's objects in preparing the papers was "to satisfy himself whether, with our present knowledge and appliances, men might reasonably hope to fly through the air." He said that in his opinion "this question can be answered in the affirmative." It meant much to the believers in the possibility of mechanical flight to have the endorsement of an engineer of the highest standing given to a discredited line of research.

In 1892 Dr. A. F. Zahm, of Notre Dame (Ind.) University, now of Washington, D. C., proposed the holding of an International Conference on Aerial Navigation in connection with the World's Congress Auxiliary of the World's Columbian Exposition of 1893.

In this Dr. Zahm was heartily seconded by Mr. Chanute, who was made chairman of the committee, Dr. Zahm being chosen secretary. The officers of the World's Congress Auxiliary, of which Mr. C. C. Bonney was president, gave cordial cooperation to the plan.

The conference formed a division of the General Engineering Congress and took place in the Memorial Art Palace, in Chicago, August 1, 2, 3 and 4, 1903. It was the first aeronautical congress held in America, and the third international one.

Mr. Chanute presided over the session on the opening day, the topic for the day being "Scientific Principles." In opening the conference he said:

> It is well to recognize from the beginning that we have met here for a conference upon an unusual subject; one in which commercial success is not yet to be discerned, and in which the general public, not knowing of the progress really accomplished, has little interest and still less confidence.

The paragraph just quoted well shows the status of interest in aerial navigation in 1893. Though peculiarly conservative Mr. Chanute expressed his conviction that dirigible balloons would presently attain a speed of twenty-five miles an hour, an estimate which is fully justified by subsequent events. He likewise maintained the practicability of achieving mechanical flight by gradual evolution, utilizing the results of the accumulated labors of many scientific contributors. He indicated the chief component problems already solved and awaiting solution. "The equipoise," said he, "is, in my own judgment, one of the most important problems yet to be solved in aviation."

The papers read at and contributed to the conference fill a volume of more than four hundred pages. The attendance averaged about one hundred at each session, comprising the most prominent men in the engineering profession.

In the summer of 1896 Mr. Chanute began his now well-known experiments on the sand dunes with man-carrying gliders. These were continued in the following year. The accounts of this very important part of his work have been fully given in various magazines and pamphlets.

Beginning with the glider of the form which had been used by the German, Lilienthal, two

years of study and experiment enabled him to produce a type having great superiority in the matter of stability, efficiency and structural strength. This was the famous Chanute biplane glider which substantially forms the conspicous body feature of the present-day biplane flying machines.

For many years Mr. Chanute was in regular communication, personally and by correspondence, with the leading aeronautic investigators in both hemispheres. The help which he gave to such men can never be fully known; the counsel and encouragement which he gave the Wright brothers in particular have been gratefully and gracefully acknowledged by them. His valuable experience, information and advice were liberally and gladly furnished to them at the time when it was most needed, when they were at the foot of the unblazed trail, and these gave them the courage and confidence which were essential to enable them to persevere and to emerge at last at the summit, triumphant.

At the Boston meeting of the American Association for the Advancement of Science, held in December, 1909, Mr. Chanute read a paper entitled "The Present Status of Aerial Navigation." This paper was the expression of his maturest understanding of the science to which he had devoted so many years of his life.

Mr. Chanute died in Chicago on the twenty-third of November last. Three daughters and one son survive him. Those who knew him will always remember his lovable character and will think of the oft-repeated saying, "He was more willing to give credit to others than to claim any for himself."

We may well believe that whenever in the future the history of aviation shall be reviewed, the name Chanute will stand forth as that of one of the few great founders.

JAMES MEANS

BOSTON, MASS.

THE AFRICAN ENTOMOLOGICAL RESEARCH COMMITTEE

WITH a view to furthering the work of the African Entomological Research Committee, Mr. Andrew Carnegie has placed at its disposal a sum of £1,000 a year for three years to defray the cost of sending a few suitably qualified young men to the United States to study the practical applications of entomology. Three of these Carnegie scholars, as they are to be called, have been selected, and two of them are already at work. Dr. L. O. Howard, chief of the Bureau of Entomology, is interesting himself in the matter and all possible facilities will be given to the scholars. It may be expected that the scheme will be of value to British administration in Africa and elsewhere by providing a body of well-trained entomologists available for employment in the services of the different colonial governments.

The Research Committee was appointed in June, 1909, by Lord Crewe, the then Secretary of State for the Colonies, with the object of promoting the study of the insects which play so prominent a part in the spread of disease among men, animals and plants in Africa, and Lord Cromer is its president. It includes some of the most eminent authorities on entomology and tropical medicine in Great Britain.

During the short period of the committee's existence satisfactory progress has been made. The scheme has been energetically taken up by the African colonies and protectorates, and the large quantity of material already received at the committee's office in the Natural History Museum at South Kensington has very materially increased our knowledge of the insect pests of Africa. The collections of insects, after being properly identified and recorded, are being distributed to the schools of tropical medicine, universities, museums, or other institutions where they are likely to be of value for the purpose of teaching or scientific study. Two skilled entomologists are being employed under the direction of the committee in East and West Africa respectively, for the purpose of interesting and instructing the local officials in the work, and also of carrying out special investigations.

The committee has issued quarterly a scientific journal, entitled the *Bulletin of Entomological Research,* of which the first volume is

just completed. Further particulars may be obtained from the secretary of the committee, Mr. Guy Marshall, British Museum (Natural History), South Kensington, London.

SCIENTIFIC NOTES AND NEWS

As a result of the recent tentative agreement between Columbia University and the Presbyterian Hospital, New York, the appointments of Dr. Theodore C. Janeway as attending physician and of Dr. William G. MacCallum as pathologist to the hospital have been announced. Dr. Janeway is professor of the practise of medicine in the College of Physicians and Surgeons and Dr. MacCallum is professor of pathology. They succeed Dr. W. Gilman Thompson and Dr. Eugene L. Opie, respectively, at the hospital.

At the last meeting of the Rumford Committee of the American Academy of Arts and Sciences the following appropriations were made: To Professor D. F. Comstock, of the Massachusetts Institute of Technology, $100 in aid of his research on the possible effect of the motion of the source on the velocity of light. To Professor G. N. Lewis, of the same institution, $150 in aid of his research on the free energy changes in chemical reactions. To Professor R. W. Wood, of the Johns Hopkins University, $150 in furtherance of his researches on the optical properties of vapors.

The following fifteen candidates have been nominated by the council of the Royal Society for election to membership: Professor H. T. Barnes, Professor A. J. Brown, Professor J. B. Cohen, Professor W. E. Dixon, Professor F. G. Donnan, Major E. H. Hills, Dr. W. H. Lang, Professor J. B. Leathes, Professor E. A. Minchin, Professor R. Muir, Mr. R. D. Oldham, Mr. R. I. Pocock, Professor A. W. Porter, Mr. H. W. Richmond and Mr. G. G. Stoney.

M. Eugène Tisserand has been elected a member of the Paris Academy of Sciences in succession to the late Professor Tannery.

The *British Medical Journal* notes various honors conferred on Dr. Paul Ehrlich, director of the Institute for Experimental Therapeutics at Frankfort. The Emperor of Russia has conferred upon him the Order of St. Anne First Class, with a badge set in diamonds. The King of Spain has bestowed on him the Grand Cross of the Order of Alfonso XII. The German Emperor has nominated him a member of the senate of the recently founded Kaiser Wilhelm Society for the Advancement of Science; on this body he is the only representative of medicine. The St. Petersburg Institute of Experimental Therapeutics has elected him an honorary member. The municipal authorities of Buenos Aires have given Professor Ehrlich's name to a street in the suburb of San Fernando.

A portrait of Sir William Crookes by Mr. E. A. Walton, as we learn from *Nature*, was presented to the Royal Society before the ordinary meeting on February 16. The presentation was made on behalf of the subscribers by Professor Meldola representing about 130 fellows of the society who had contributed to the fund. Sir Archibald Geikie, as president, accepted the portrait on behalf of the society. Sir William Crookes expressed his thanks to the subscribers for the honor they had conferred upon him. In the course of his remarks he said that in two years he hoped to celebrate the jubilee of his fellowship, as his election dated from 1863.

Professor W. W. Watts, F.R.S., has been elected president of the Geological Society of London. The following awards of medals and funds have been made: Wollaston medal, Professor Waldemar C. Brögger; Murchison medal, Mr. R. H. Tiddeman; Lyell medals, Dr. F. A. Bather and Dr. A. W. Rowe; Bigsby medal, Professor O. Abel; Wollaston fund, Professor O. T. Jones; Murchison fund, Mr. E. S. Cobbold; Lyell fund, Dr. C. G. Cullis; Barlow-Jameson fund, Mr. J. F. N. Green.

We learn from *Nature* that the Lannelongue prize, founded last year by Professor Lannelongue, of Paris, has been presented to Sir Victor Horsley, F.R.S. The prize is a gold medal and the sum of $1,000, and it is awarded to the person who had contributed most to the progress of surgery in the ten years before the date of the award. It is open to surgeons of all nations, and is to be

awarded every five years during the annual meeting of the Société de Chirurgie.

The Fothergillian gold medal, of the Medical Society of London, given triennially, has been awarded to Dr. F. W. Mott, F.R.S., for his researches on the nervous system.

President Schurman has been appointed by the faculty and trustees of Cornell University a delegate to the celebration on September 12 to 15 next, of the five hundredth anniversary of the founding of St. Andrews University. He has also been appointed a delegate to represent the university at the centenary celebration of the University of Christiania, Norway, to be held September 5 and 6.

A six months' leave of absence, owing to illness, has been granted to Dr. E. B. Voorhees, professor of agriculture at Rutgers College and director of the New Jersey Experiment Station.

Professor Otto C. Glaser, of the department of zoology in the University of Michigan, has been granted leave of absence for the academic year 1911–12.

T. D. Urbahns, instructor of entomology at the Minnesota Agricultural College, has resigned to enter the government service. He will go to Salt Lake City to take up an investigation of the alfalfa weevil.

The appointment of Dr. L. Van Es as a member of the permanent commission of the International Veterinary Congress in the place of Dr. Leonard Pearson, deceased, has recently been announced. Dr. Van Es is head of the School of Veterinary Medicine at North Dakota Agricultural College, Fargo, N. D.

Captain Horace D. Bloomberg, of the U. S. Army Medical Corps, who has been a member of the Army Board for the Study of Tropical Diseases, has completed his term of duty in the Philippines and is returning to the United States.

Mr. K. R. Lewin, Trinity College, Cambridge, has been nominated to use the university table at Naples for six months from March 1.

In response to the request of the Chinese government for an international commission to proceed to China to investigate the outbreak of plague in Manchuria, the British government has instructed Dr. Reginald Farrar, one of the medical inspectors of the local government board, to proceed to China.

Dr. C. P. Steinmetz, consulting engineer for the General Electric Company, was a guest of the University of Illinois during the week of March 6 to 11. During his stay he delivered lectures on "Electric Energy" and on "Transients."

Dr. E. B. Titchener, Sage research professor of psychology in Cornell University, addressed a convocation of the students and faculty of Indiana University, on February 23, on "Memory and Imagination." On the evening of February 9, the members of the Purdue chapter of Sigma Xi were the guests of the Indiana University chapter at a banquet and lecture. The lecture was given by Professor R. B. Moore, of Butler College, on the subject of "The Rare Elements of the Atmosphere."

Colonel G. W. Goethals, chief engineer of the Panama Canal, appeared as the ninth lecturer upon the J. C. Campbell Foundation of the Sigma Xi Society of the Ohio State University on February 21. A large audience gathered to hear him speak upon the subject "The Panama Canal." His lecture was illustrated by a large number of slides and also a film of moving pictures showing some of the machinery used upon the canal in operation.

Professor Charles H. Judd, director of the school of education at the University of Chicago, and Professor John M. Coulter, head of the department of botany, spoke at the annual convention of the Central Kansas Teachers' Association, which met at Salina on March 2, 3 and 4.

On February 10, Dr. Wallace W. Atwood, of the University of Chicago, spoke at Princeton, Ill., on "Conservation in Illinois," emphasizing the work of the State Park Commission, of which he is a member.

Sir Horace Plunkett, the Irish authority on cooperation in agriculture and member of

the English parliament, delivered an address before the faculty and students of the University of Wisconsin and the members of the state legislature last week on "The State, the University and the Farmer." He also held a conference with the members of the faculty of the college of agriculture on conditions of agriculture in America.

THE Rational Geometry of Professor George Bruce Halsted has been translated into French and will be published by the firm Gauthier-Villars.

WE regret to note the death of Professor Edwyn Carlos Reed at Concepcion, Chile. He was director National Museum at Concepcion and had for many years studied the flora and fauna of Chile. His work in natural history was largely devoted to the popularization of scientific knowledge and to the spread of economic ideas in economic zoology. He leaves one son, Carlos S. Reed, who is now professor in the School of Viticulture.

COLONEL R. M. BEDDOME, known especially for his publications on the ferns of India, died in London, on February 23, at the age of eighty-three years. The deaths are also announced of Dr. C. Alexander MacMunn, of Wolverhampton, known for his research work in physiological chemistry, and of Dr. William Williams, of South Wales, an authority on sanitation.

A BILL has been introduced into the general assembly of Illinois that provides for the establishment of a State Board of Forestry and a state forester. It is provided that the office of the state forester shall be located at the State University and that the forester shall teach at the university.

A SOCIETY for the erection and maintenance of an institute for the treatment of cancer and for research, has been founded at Munich. The president is Prince Ludwig Ferdinand, doctor of medicine.

THE Vallauri prize of the Turin Academy of Sciences will for the coming three-year period be awarded for a work in Latin literature, for the following three-year period, from January 1, 1915, for the most important work published in the physical sciences. The value of the prize is $5,000.

THE Field Museum of Natural History announces its thirty-fourth free lecture course as follows:

March 4—"Precious Stones, how they are Found and Manipulated," Dr. George F. Kunz, New York City.

March 11—"The Glacial History of the Great Lakes," Professor Frank Carney, Denison University, Granville, Ohio.

March 18—"The Sugar Maple and Maple Sugar Making," Professor L. R. Jones, University of Wisconsin.

March 25—"Peking," Dr. Berthold Laufer, associate curator of Asiatic Ethnology, Field Museum.

April 1—"Picturesque Sweden," Professor James H. Gore, Washington, D. C.

April 8—"The Real Filipino," Professor Arthur Stanley Riggs, New York City.

April 15—"Photographing the Heavens," Professor G. W. Ritchey, Mount Wilson Solar Observatory, Pasadena, Cal.

April 22—"Recent Discoveries of Petroleum in the United States and Mexico," Dr. David T. Day, U. S. Geological Survey, Washington, D. C.

April 29—"Turkestan; the Heart of Asia," Mr. William E. Curtis, Washington, D. C.

UNIVERSITY AND EDUCATIONAL NEWS

THE sum of $7,000 has been received by the University of Michigan from the estate of Emma J. Cole, of Grand Rapids, Michigan, to constitute a scholarship fund for graduate students in botany.

THE regents of the University of Wisconsin have accepted as a trust the sum of $30,000 for the establishment and maintenance of a chair to be known as the Carl Schurz memorial professorship. The chair is to be filled by professors from the universities of Germany. The present size of the fund will make it possible to secure a German professor for one semester every second year. President Van Hise has been authorized to open negotiations with German authorities with a view to establishing a system of exchange professors between German universities and the University of Wisconsin. The es-

tablishment of the Carl Schurz professorship will be celebrated with appropriate exercises on March 31. The speakers on that occasion will include the two German exchange professors now in this country, Dr. Max Friedlaender, of the University of Berlin, now at Harvard, and Professor Ernst Daenell, of the University of Kiel, Kaiser Wilhelm professor at Columbia.

It was recently stated in this journal that among other conditional appropriations the General Education Board had made one for the Wesleyan College for women. It should have read Western College for Women, an institution situated in Oxford, Ohio.

The Kansas legislature has passed the bill to abolish boards of regents of three state schools and to substitute a commission of three to be appointed by the governor and to receive salaries of $2,500 a year each, to manage the State University, the State Normal College and the State Agricultural College.

President James has asked the senate of the University of Illinois to appoint a committee to draft a university constitution, marking off the legitimate authority which should be given to such an institution by the legislature, defining the relations between the legislature and the state administration, on the one hand, and the university on the other, and dividing up and marking off the functions of trustees, faculties, students and alumni. Among questions to be considered by such a committee would be the powers of university trustees, the function and power of the president, the duties of deans, the general division of the university itself into faculties, the authority of individual faculties. The authority of the professor in his own department; his tenure of office; his independence of investigation and teaching, freedom of speech, pension system, salary schedule; method of determining the budget, powers of discipline of faculties over their own members and over their students are all subjects which would call for consideration in such a constitutional convention. It is proposed to submit this constitution, after it is drafted, to a full discussion, first in the senate, then in the university faculty, and finally, after working it out in detail, to submit it to the board of trustees, and after their modifications, to send it to the legislature for enactment into positive law.

The University of Christiania will celebrate the centenary of its foundation in December next. Dr. W. C. Brögger, professor of mineralogy and geology, will preside as rector of the university.

Dr. Alexander Smith, professor of chemistry in the University of Chicago and dean of the junior colleges, has been elected to the Mitchill professorship of chemistry at Columbia University, vacant by the appointment of Dr. Charles F. Chandler as professor emeritus.

Dr. Alfred Stengel will succeed Dr. David L. Edsall as professor of medicine at the University of Pennsylvania. Dr. John H. Musser was unwilling to accept the position. In the same institution Dr. Milton B. Hartzell has been appointed professor of dermatology in succession to Professor Louis A. Duhring, who has recently been appointed professor emeritus. Professor John B. Deaver has been appointed professor of clinical surgery.

At Columbia University the following have been advanced from instructors to assistant professors: Hal T. Beans, Ph.D., and Floyd J. Metzger, Ph.D., chemistry; Everett J. Hall, assaying; Samuel Osgood Miller, C.E., drawing; Charles W. Thomas, Mech.E., mechanical engineering; Harry P. Parr, Mech.E., mechanical engineering, and Edward F. Kern, Ph.D., metallurgy.

Dr. William McKim Marriott, assistant to the chair of physiological chemistry in Cornell Medical School, has been appointed instructor in biological chemistry in Washington University, St. Louis.

Dr. Pehr Olsson-Seffer, director of Tezonapa Botanical Station, has been appointed professor of botany at the National University of Mexico. He will lecture on the history of botany, evolution of plants and ecological plant geography, and give courses in plant physiology. In the absence of botanical laboratories at the university, the work in plant physiology will be conducted at the Tezonapa Botanical Station. Dr. Olsson-Seffer has also

recently accepted the post of Government Botanist in charge of the botanical section of the Biological Commission of the Department of Agriculture and of the Bureau of Forestry in Mexico.

DISCUSSION AND CORRESPONDENCE

SOILS AND CROPS

IF we accept Professor Chamberlin's view, "that the total eon of productive soils may be assigned a period of at least tens of millions of years" (as expressed in his article on "Soil Productivity" in SCIENCE, February 10, 1911, and if we accept his endorsement of Cameron's estimate for the United States that the capillary waters are carrying potassium toward the surface at the rate of from 40 to 83 pounds per acre per annum, while the total average removal amounts to only 23 pounds (20 pounds in crops and 3 pounds in drainage), then we might expect the potassium to accumulate in the surface soil at the rate of 1,700 to 6,000 pounds per acre per century, or at the rate of 17,000 to 60,000 pounds per thousand years, on normal level lands not subject to surface erosion; we might expect the surface soils to be many times richer in potassium than the corresponding subsoils, and the older soils to be much richer than those of more recent but similar origin.

In contrast with these theoretical deductions the science of chemistry reveals the facts,[1] for example, that the common prairie lands of the oldest Illinoisan Glaciation contains as an average 12,470 pounds of potassium per million of dry surface soil and 14,050 pounds per million of the subsoil; that the more recent Early Wisconsin Glaciation contains 18,120 pounds in the surface and 19,650 pounds in the subsoil; and that the Late Wisconsin Glaciation contains 22,510 pounds in the surface and 26,690 in the subsoil.

The corresponding timbered soil types contain, in the oldest Illinoisan Glaciation, 15,100 pounds of potassium (per million of dry soil) in the surface and 16,050 pounds in the subsoil; while in the Early Wisconsin Glaciation the respective amounts are 18,080 and 21,100; and in the Late Wisconsin Glaciation there are 23,800 pounds in the surface and 26,100 in the subsoil, per million of dry soil.

[1] Illinois Experiment Station Bulletin 123 and unpublished data.

If two inches of water soak into a soil and if one inch escapes by evaporation and the other by subdrainage, the net result is not gain but loss of soluble minerals, under normal conditions. In level or slightly undulating upland areas, such as the loess-covered prairies of the Central-West, which neither receive deposits from overflow nor lose partially depleted soil by erosion (especially while protected by prairie grasses), the operation of the natural law tends steadily toward soil depletion, with respect to the mineral elements; and this law has been in operation since the glacial or loessial age, wherever the climatic conditions have been similar to those now prevailing in our humid sections. The accumulation of organic matter (including some phosphorus) in such glacial or loessial soil begins some time after its deposition and continues until a maximum is reached, after which the organic matter, as well as the valuable mineral elements, tends to decrease, the latter because of leaching, as from the beginning, and the former because the rate of decay finally exceeds the rate of growth or accumulation.

That phosphorus is an essential constituent of the living tissues of plants and that it accumulates in plant residues in prairie soils are well-established facts, but a theory that the phosphorus brought to the surface in capillary moisture exceeds that removed by crops and drainage is not supported by the composition of soils of similar origin and different age. Thus ultimate analysis shows per million of dry surface soil 420 pounds of phosphorus in the oldest Illinoisan Glaciation, 595 in the more recent Early Wisconsin, and 705 pounds in the Late Wisconsin.

Even the theories of the federal Bureau of Soils and the estimates of the United States Department of Agriculture must be heavily discounted if they stand opposed to established facts; for one fact outweighs a thou-

sand opinions based upon erroneous theories or estimates.

As a rule our meat is made from corn, and our bread from wheat. An average of the last five or six years compared with an average of a like period ten years before reveals the following data taken from the Year Books of the United States Department of Agriculture:

1. The average annual production of corn in the United States increased during this ten-year period from 2074 million to 2733 million bushels.

2. The average exportation of corn from the United States decreased from 177 million to 67 million bushels.

3. Consequently, the average annual supply of corn for our domestic use increased from 1897 million to 2666 million bushels—an increase of 40 per cent.

Now, if we keep in mind that every figure here given is based upon an average of at least five years, and also keep in mind that the population of the United States increased only 21 per cent. from 1900 to 1910, then we may well ask, if the supply of corn for home use has increased 40 per cent. and the population only 21 per cent., what have we done with such an enormous surplus of corn retained in this country?

A study of the statistics for wheat reveals the following data:

1. The average annual production of wheat increased during the ten-year period from 528 million to 669 million bushels.

2. Our average exportation of wheat decreased from 185 million to 110 million bushels.

3. Consequently, the average annual supply of wheat for our domestic use increased from 343 million to 559 million bushels—an increase of 63 per cent.

Here, too, we may well ask, if the supply of wheat for our home use has increased 63 per cent. while the population increase is only 21 per cent., what have we done with a retained surplus of wheat amounting to 42 per cent. above the increase in our population?

Under the Illinois laws about fifteen hundred township assessors report to the Illinois State Board of Agriculture the acreage of the various important farm crops grown in all the townships of the state. A comparison of two five-year periods, 1895 to 1899 and 1905 to 1909, shows that the average area of corn grown in Illinois increased in ten years from 6,950,000 to 7,340,000 acres, according to the assessors' returns, working under the same law during this entire period; whereas, according to the estimates reported by the United States Department of Agriculture, the Illinois corn area has increased from 6,910,000 to 9,700,000 acres. In other words, the state assessors report an increase of less than 6 per cent. while the federal report shows an increase of more than 40 per cent. in the average Illinois acreage of corn.

If we consider our three great grain crops, corn, oats and wheat, the Illinois state report shows the total average production to have decreased by 1 per cent. during this ten-year period, but the federal crop report credits Illinois with an increase of 41 per cent. in her production of grain during the same period.

For 1910 the Illinois State Board reports 281 million bushels of corn; while the U. S. Department reports 415 million bushels as the Illinois crop. Likewise the Ohio state officials report 105 million bushels, and the federal estimate credits the state of Ohio with 145 millions of corn produced in 1910.

All of these comparisons seem to reveal the influence of a strong spirit of optimism on the part of the federal department of agriculture, which, however, is supported neither by the assessors' report nor by the existence of any important reserve supplies, nor by the increased price of grain and meat and the high cost of plain living. In the last report of the United States Secretary of Agriculture it is stated that the value of our agricultural products rose from 4417 million dollars in 1898 to 8926 million dollars in 1910—an increase of more than 100 per cent. in twelve years; but shall we rejoice or weep when we consider that this enormous increase in value is not due to improvement of soil but to the estimated increase of acreage in crops and to

the actual increase in prices for food that must be paid by our own citizens?

On the other hand, even the crop "statistics" of the department of agriculture show that the average yield of corn per acre in the entire United States was 25.6 bushels for the twenty years 1870 to 1889, and only 24.9 bushels for the twenty years 1890 to 1909, an average decrease of 0.7 bushel; while the "statistics" for wheat show 12.2 and 13.6 bushels as averages for the corresponding periods, an increase of 1.4 bushels, with millions of acres of virgin wheat lands brought under cultivation. As an average the "statistics" show an increase of 7 per cent. in yield per acre for these two greatest food-grain crops; while our population actually increased 51 per cent. during the same period. Curves projected from these data may not be alarming to those of the present generation who have not yet felt the high cost of living, but they look less comfortable for our own children.

True optimism is admirable, but blind optimism is dangerous. The undersigned has great faith that permanent general prosperity and progress will ultimately be secured for the people of the United States—not that kind of existence enjoyed (?) by the densely populated sections of China, which requires frequent readjustments, as now in progress[2] with the certainty of a sudden reduction in population numbered by the million; not a condition under which men and even women gather "the katamorphic products of human food-consumption" for a year, in order to recover and return to the soil an amount of phosphorus per individual equal in value to that for which we now receive at our phosphate mines only two cents from the exporter; but we seek rather a higher civilization whose achievement shall be based upon a knowledge of the fact that to insure permanent prosperity we must increase production and limit reproduction—especially the reproduction of the unfit, whose support in penal and charitable institutions already consumes about half the total revenues of the state governments.

[2] Nanking, China, February 3, 1911.—That the deaths due to famine and the pestilence following in its wake will total a million before spring was the estimate submitted to the relief committee here to-day. Relief workers are aghast with the realization of the task before them. Even were they in receipt of unlimited contributions for relief, the missionaries, doctors and other volunteer workers would be almost hopeless in the face of two and one half millions of suffering people in the Anhui and Kiang Su provinces. The famine is an old story in China, but the most experienced relief workers declared to-day that the present prospect is the worst in many years. —*From Press Dispatch.*

Even though the high civilization of the ancient Mediterranean countries "went down into the dark ages with laughter," all must recognize and admire the recent agricultural developments in western European countries; but shall we ignore the fact that for five million dollars we are exporting annually to Europe a quantity of our highest-grade phosphate sufficient for the production of 1400 million bushels of wheat, that would be worth at least a thousand million dollars to the oncoming generations of Americans?

It is true that Denmark produces 40 bushels of wheat per acre, compared with 14 bushels in the United States, but Denmark produces only 4 million bushels of wheat, and then imports 5 million bushels of wheat, 15 million bushels of corn, the same amount of barley, 800 million pounds of oil cake, as much mill foods, and large amounts of phosphates, saving and using the imported fertility; and paying for it all with profit by exporting hundreds of millions of pounds of butter and bacon to a country whose degree of prosperity is measured by her profits from trading upon the prosperity and poverty of other larger countries.

The fundamental doctrine of the United States bureau of soils is indeed a pleasant one, and highly important if true, but exceedingly dangerous and condemnable if not true. It reads as follows, in exact quotations:

1. "That practically all soils contain sufficient plant food for good crop yields; that this supply will be indefinitely maintained."—Bureau of Soils Bulletin (1903) 22, p. 64.

2. "There is another way in which the fertility of the soil can be maintained, viz., by arranging a system of rotation and growing each year a crop that is not injured by the excreta of the preceding crop."—U. S. Farmers' Bulletin (1906) 257, p. 21.

3. "The soil is the one indestructible, immutable asset that the nation possesses. It is the one resource that can not be exhausted; that can not be used up."—Bureau of Soils Bulletin (1909) 55, p. 66.

4. "From the modern conception of the nature and purpose of the soil it is evident that it can not wear out, that so far as the mineral food is concerned it will continue automatically to supply adequate quantities of the mineral plant foods for crops."—Bureau of Soils Bulletin (1909) 55, p. 79.

If again we turn from theory to science, we find at the Rothamsted Station in a four-year rotation, including always a legume crop, that the yield of turnips decreased from 10 tons in 1848 to less than 1 ton per acre as an average for the last 20 years; that the barley decreased from 46 bushels in 1849 to 14 bushels as an average for the last 20 years; that the clover has decreased from 2.8 tons per acre in 1850 to less than one half-ton average since 1890; and that the wheat produced 30 bushels in 1851, and 33 bushels average during the next 12 years, but only 24 bushels since 1890, and 20 bushels per acre since 1900.

As an average of the last twenty years the value of the four crops on the unfertilized land at Rothamsted is $33.83 (from four acres), but where the same crops were grown on adjoining land to which mineral plant food had been applied the average value is $76.83, the increase being 140 per cent. above the cost of the minerals. Let us thank God for Rothamsted, and be grateful that agriculture has some facts.

Likewise at State College, a four-year rotation, including clover, has been practised for nearly thirty years, but as an average of two consecutive 12-year periods the value of the four crops (corn, oats, wheat and hay) decreased from $44.20 to $32.72; but where mineral plant food was applied the crop yields averaged 49 per cent. above the unfertilized yields.

Both the teaching of science as applied to agriculture and the practise of farming, in America, have suffered and still suffer from an insufficient accumulation of facts and from an over-production of theories and conclusions.

While famine is frequent in China and Russia and almost constant in India—the only great populous agricultural countries comparable with the United States in necessary self-dependence—and while the beautiful level upland Leonardtown loam soils of southern Maryland, near the city of Washington, still lie agriculturally abandoned, with only 80 pounds of total phosphorus and 500 pounds of total calcium per million in the surface soil (facts discoverable even in Bureau of Soils Bulletin 54), shall we encourage the Whitney-Cameron doctrine[3] *that it is never necessary at any time to introduce fertilizing material into any soil for the purpose of increasing the amount of plant food in that soil?*

Cyril G. Hopkins
University of Illinois

BROWNIAN MOVEMENTS AND MOLECULAR REALITY

To the Editor of Science: I have recently received a copy of Mr. F. Soddy's English translation of Professor Jean Perrin's paper on "Brownian Movements and Molecular Reality." Its perusal recalls to mind some ideas I have entertained for a number of years relative to a general physical theory based on very simple facts or principles. The earliest record I have of these ideas is in a memorandum note of November 10, 1897. In a letter of January 30, 1900, to Professor Peter S. Michie, of the department of philosophy, U. S. Military Academy, West Point, the ideas referred to were outlined rather more clearly and I also presented a brief statement of them under date of August 11, 1900, to the International Congress of Physics which was held at Paris in connection with the Universal

[3] Hearings before the Committee on Agriculture of the United States House of Representatives (1908), page 446; or Ginn & Company's "Soil Fertility and Permanent Agriculture," page 315.

Exposition of that year. A brief paper on the subject was presented to the American Physical Society in 1903, and an abstract of this paper was published in the *Physical Review* for April, 1903, but the complete paper with diagrams has not been published. The title of the paper was "A Simple Geometrical Principle and its Possible Significance in Connection with a General Physical Theory," and the principle referred to was stated as follows:

In an aggregation of an indefinite number of equal spherical bodies an arrangement giving minimum total volume and perfect symmetry throughout is impossible.

Three different arrangements of a group of spherical balls of equal size were considered: arrangement A, in which twelve of the balls are grouped about a central one, so the surrounding balls are tangent to the central one and to each other throughout; arrangement B, in which twelve balls are symmetrically disposed about and touch a central one, but nowhere touch each other, and arrangement C, in which the balls have the cubical arrangement, or the one in which the mutually tangent planes form cubes. The following is quoted from the published abstract referred to above:

The assumption is now made that the balls come together in a collection under their mutual attractions according to gravity laws. They will not assume or remain in arrangement C because while this gives symmetry throughout it is not the most compact possible and the equilibrium of the collection would be unstable.

Arrangement A, while the most compact possible for an indefinite number of balls in contact throughout, is not entirely symmetrical.

Arrangement B gives a perfectly symmetrical disposition of twelve balls with respect to a central ball but it is geometrically impossible throughout a collection of a greater number than thirteen.

It is suggested that under the conditions assumed the result will be that the balls will assume no fixed arrangement, but that they will be in continual relative movement, striving after the unattainable arrangement that will give minimum total volume, symmetrical disposition, and therefore fixed stable equilibrium throughout.

So far as I can now recall, I had not learned of the Brownian movements at that time. I certainly did not have this phenomenon in mind when the paper was written. I have not been able to make out that Professor Perrin's paper contains any very clear explanation of or theory as to the underlying *cause* of the Brownian movements, or that it purports to suggest such an explanation or theory, but the relations between the actual phenomenon as described and the above quoted speculation seemed to me rather striking.

In my mind the Brownian movement paper tends to confirm the idea that the "simple geometrical principle" above described is deeply significant, if it is not indeed a general and fundamental principle of physical phenomena.

JOHN MILLIS,
Col., Corps of Engineers, U. S. Army

FURTHER EARLY NOTES ON THE TRANSMISSION BY FLIES OF THE DISEASE CALLED YAWS

I HAVE previously published in SCIENCE[1] two notes on the transmission of this tropical disease by flies. The earlier reference bears date of 1769 from Guiana. The second, while of much later date (1817), indicates that in Brazil at that time the infection was conveyed by a certain fly recognizable by its small size.

Shortly after the publication of this second note, I received a letter from Professor J. B. Woodworth, leader of the Shaler Memorial Expedition to Brazil in 1908–09, in which he kindly called my attention to a further account of this phenomenon in Walsh's "Notices of Brazil." While spending the recent holidays at Washington at work in the Library of Congress, I looked up this reference and also found another and earlier statement. Believing that these accounts may not be devoid of interest and value, they are herewith reproduced.

The one referred to by Professor Woodworth is found in "Notices of Brazil in 1828 and 1829," by R. Walsh, published in Boston in 1831. On page 224 of volume I. we read:

A disease, called in the country *bobas*, is frequently attended with fearful consequences. It

[1] January 7 and November 4, 1910.

resembles the frambesia or yaws of the West Indies. The body swells and breaks out into ulcers, which have often the appearance of mulberries, and the patients become exceedingly loathsome. It is infectious by contact, but is also communicated, *according to the theory of the country*,[2] in a manner that defies all precaution. The eye sometimes is partially affected, and a small fly is then attracted by the discharge; this insect comes loaded with the contagious matter, and communicates it to the next person, on whose face he happens to light.

It will be noted that Walsh agrees with Koster's statement[3] that the disease is transmitted by a certain "small fly from which every precaution is oftentimes of no avail" and that the eye is the part most likely to be affected.

An earlier account of this means of infection is found in J. G. Stedman's "Narrative of a Five Years' Expedition Against the Revolted Negroes of Surinam, in Guiana on the Wild Coast of South America," London, 1796. On page 274 of volume II. he writes:

The yaws, a most disagreeable disorder, by many compared to the venereal disease, renders the patient a shocking spectacle, all covered over with yellow ulcers. To this last mentioned loathsome malady most negroes are subject, yet but once only in their lives, in which, and in being very infectious, it resembles the small-pox: indeed, if a fly which has been feeding upon the diseased (and they are generally covered with them) lights upon the slightest scratch on a healthy person, it communicates this dreadful disorder, which always confines him for several months.

The earliest references to this disease which I have chanced upon are from William Piso. The first occurs under the heading De Lue Venerea on page 35 of his De Medicina Brasiliensi in "Historia Naturalis Brasiliæ," by William Piso and George Marcgrave. Under the heading De Lue Indica the same facts are given almost verbatim on page 43 of Book II., De Natura & Cura Morborum, Occidentali Indiæ, imprimis Brasiliæ, familiarum, in Piso's "Historiæ Naturalis & Medicæ Indiæ Occidentalis," one of the component parts of "De Indiæ Utriusque Re Naturali et Medica," by William Piso and Jacob Bont. The first was published at Leyden and Amsterdam in 1648, the second at Amsterdam by the Elzevirs in 1658.

[2] Italics by the present writer.

[3] See "Note," etc., November 4, 1910.

That part of the account of the disease which is of interest to the general reader translates as follows:

Concerning the Venereal (or Indian) Disease (or Plague). This is a disease which occurs not only in children as a result of inheritance from their parents, and is contracted not only by infection in sexual union, but even by lighter contact. It originates chiefly in fetid and decaying food, and in rancid and corrupt drink. It rages not only among Negroes and Indians, but also among Portuguese and Dutch. The whole body is infested with schirrhous tumors and virulent ulcers. This disease is indeed endemic in that region [Piso was writing of northern Brazil] and by both Spaniards and Brazilians is called *Bubas.*

Careful search failed to show any reference to insects as agents of transmission.

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A THEORY OF SEX DETERMINATION [1]

MRS. LAURA A. CALHOUN, a woman of culture, who has had considerable experience in the breeding of animals in California, ventures on the strength of this experience and that of others to propose and develop a theory of the conditions determining sex.

Her main thesis is set forth in these words: "The sex of the embryo in man and the higher animals is determined in the ovary from which the ovum in question is developed. In the normal female, the ovary of the right side yields ova which on fertilization develop as males, and the ovary of the left side yields ova which are potentially female."

From this arises the practical deduction that sex can be determined at will, through the service of gravitation. For the prospective mother to lie on the right side should

[1] "The Law of Sex-determination, and its Practical Application," by Laura A. Calhoun, The Eugenics Publishing Company, New York.

ensure male offspring. To allow the spermatic fluid to flow to the left side means female offspring.

Besides the main thesis, Mrs. Calhoun takes up the general subject of heredity, with quotations from leading authorities, matters likely to be interesting and helpful to those for whom the book is written, much of this being addressed especially to women. A new theory, called telegyny, is suggested, the effect of the first female on the male, a theory which is probably as well founded as its prototype, telegony, the supposed effect of the first male on the female, a scantily supported hypothesis, thus far lacking adequate verification.

Mrs. Calhoun writes in a frank, modest, friendly style, which disarms technical criticism. The present writer is not convinced that the theory in question is correct. But to say this is only to say that one of the central problems in biology still awaits a final decision.

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QUOTATIONS

THE ANTIVIVISECTIONISTS

BECAUSE a woman, crazy about cats, subsidized a lawyer and a press-agent for an indefinite length of time, the state of New York must face every year some bill aimed at scientific research. There are various organizations of this type, varying in the amount of absurdity and of harm. The Society for the Prevention of Cruelty to Animals has possibly put an end to its usefulness by swinging over to the antiexperiment camp. The act which has been introduced this year shows that the American societies, defeated again and again, have taken a lesson from England and are now asking for investigation instead of restriction. Pasteur and Koch could not have done their work as the British law stands to-day. Of course, investigation is a plausible term. As a matter of fact, what the opponents of scientific progress object to is experiments which are fully set forth in scientific publications. Investigation would be a mere form of sentimental agitation. The scientists make no concealment of what they are doing. On the contrary, they give it all the publicity they can obtain. We can hardly believe that the present is a favorable moment for these dangerous sentimentalists to succeed. The death-rate from meningitis only two or three years ago was from seventy to eighty per cent. Now the rate, counting all cases, is twenty-five per cent., and in the cases where the serum is given early it runs as low as six to eight per cent. Among those cases which were called cured before the serum was discovered were the long-drawn-out and most painful ones which left imbecility or some frightful deformity. These cases now have absolutely disappeared. As this triumph over one of the most terrible and agonizing diseases, from which the principal sufferers are children, is so fresh in the mind of the public, it hardly seems possible that a backward step should be taken. Dr. Flexner and the Rockefeller Institute, in conquering meningitis, used twenty-five monkeys and about two hundred guinea-pigs and rabbits.

There is one dreadful and destructive disease which men hesitate to name. It struck down not only the guilty, but millions of innocent women and millions of innocent children. That disease has within a few months been mastered by a drug, the most perfect drug antidote in the world. The cost of conquering this disease was a few rabbits and a few mice.

Dr. Carrel, only a short time ago, perfected the delicate operation of transfusion of blood, which is now saving many lives. The cost here was a few kittens; the societies would much rather have had the kittens put into a bag and thrown into the river.

Infantile paralysis filled this country with terror a few months ago. The experiments which have taken place since then mean that this disease will be handled much better next summer, and there is every promise that before long it will be exterminated. Doubtless in the process a few animals will meet their death in the service of science, instead of in the ordinary form. There are a number of mice now suffering from cancer in order that

one of the most deadly and most painful of diseases may be conquered. The Society for the Prevention of Cruelty to Animals ought to bend all of its energies to stopping the men of science from making any use of these mice. If they do not successfully interfere, it is likely that cancer may be conquered as thoroughly as diphtheria, which has been reduced from one of the most destructive scourges of children to a point where, if the antitoxin is taken in the first twenty-four hours, the death-rate is only about one and a half per cent.

A fight is going on against the gipsy moth, the hookworm, and other well-meaning inhabitants of the globe. We suggest that bills be introduced by humanitarians into all the legislatures to protect these guiltless creatures. Rats are unpopular just now because of the fact that they carry the bubonic plague and other diseases. There ought to be organized at once a society for the protection of rodents.

The more reasonable these bills may be made to sound, the more chance there is that they may accomplish some unspeakably fatal blow against the human race. There are laws now in plenty forbidding cruelty. The great institutions which are specially aimed at by the cranks, like the Rockefeller Institute, are in the hands of men who are spending their lives in the cause of solid and real kindness. Shall we take away from splendidly equipped experts of devoted character the right to judge what experiments are necessary, and put the question into the hands of some fool committee made up of persons in whom hysterical excitement takes the place of knowledge?—*Collier's*.

SCIENTIFIC BOOKS

ELEMENTARY BIOLOGIES

Biology is unique among her sister sciences in the wealth of variation in the methods of presenting the subject to beginners. It has been truly said that there are as many methods in this work as there are men conducting it. In the minds of many, this is as it should be, for there are requirements for one which are not for another. The technical school emphasizes certain things which will not form a part of the course given in the classical college. The material or *content* varies.

It is a question in the writer's mind as to how much the *method* of presentation should vary in the several conditions. The following well-marked methods of teaching beginning biology are recognizable: (1) Biology as an integer, not resolved into its components, zoology and botany. As subdivisions of this category, one finds: (*a*) The type method, introduced into this country when Martin, in 1868, adapted Huxley's "Biology" to the students entering American colleges at that time. The evolutionary chain was emphasized and morphology was predominant. (*b*) The two-type method, which Sedgwick and Wilson used in their text, one animal and one plant being selected and studied exhaustively, others being presented as comparisons. The functions of living matter were considered equally with the morphological features. (*c*) A method, not especially new but well marked in the "General Biology" of Needham,[1] where the *principles* are emphasized, illustrations being selected towards that end and morphology reduced to a minimum; types as such are scarcely recognizable. With the second great division (2), the science is resolved into its components, zoology and botany, but we may distinguish here, as before, well-marked subdivisions, (*a*) where the biological aspect is maintained and (*b*) where the work is presented as purely botany and purely zoology, with no reference to the common ground between them.

There have been published recently, in this country and abroad, several books whose purpose is to fill one of the fields given above. Kirkaldy and Drummond[2] have followed 1*a* in giving a discussion of isolated types, with little intercommunicating cement. If biology is a science, as chemistry is a science and physics is a science, having definite content and definite principles, one would never de-

[1] Comstock Publishing Co., Ithaca, 1910.

[2] "An Introduction to the Study of Biology," Oxford, 1909.

termine the fact from this English text. There is left in the mind of the student a series of chapters from the story-book of living things, each complete in itself and bearing only remotely upon what precedes or follows. The clever student will find the thread, but only he.

At the present time, no text has been written from the point of view of the Sedgwick-Wilson method, although there is in progress a book which will embody this idea, the types being somewhat different. Therefore it can not be assumed that this method is being abandoned, as judged by the production of texts representative of it.

The text of Professor Needham, referred to above, must be classed separately. As we have already said, principles are considered in the light of selected examples, which are described in so far as the matter in hand demands. If this point be borne in mind by the reader of the book, he will scarcely urge the criticism that the treatment is superficial. The illustrations, many of which are original, are supplemented by photographs, and the quality of book-making is such that the figures, although inelaborate, are ample. The absence of time-honored pictures is refreshing. The attempt to bring into the book the results obtained in the laboratory of the investigator of the present is happily accomplished. The work of the American school of cytologists and the experimental or analytical school in general is covered, briefly, it is admitted, but, in the mind of the reviewer, logically and sufficiently clearly to be appreciated by the student. Much of the data of the volume concerns the insect world and this is readily understood when the principal interest of the author is considered. It may be said that there is little material discussed in the book which is not readily placed in the hands of the students of any institution.

The beautifully illustrated little book of Dr. Kraepelin[3] is moulded in a manner similar to the text of Needham. Professor Needham's book may be used as a laboratory guide and field companion, and in this respect it differs from all other texts mentioned here, with the possible exception of the one of Hegner. It is a matter much to be regretted that the students of American institutions of learning, even after they have passed two or three years in the work, are unable to use books written in foreign languages. There is no English volume which can approach this German book in wealth of text-figures, some of which are colored. The text itself is well in keeping with the book-making, and in the experience of the writer the book as a whole is inspiring to the student who can master the written word, little as it may be. The futility of presenting a book of the quality of Kraepelin's to English students is readily seen when one attempts to translate the book into English and put it upon the market at a German standard, still maintaining the selling price of the original (four Marks). Some cooperation may sometime be possible between the departments of Romance and Germanic languages and the scientific departments of our universities and colleges which may be beneficial to both.

McFarland's[4] book can scarcely be called a text, but rather a reader. As such it will be useful, although the illustrations are poor throughout, many of no value whatsoever and the language is at least the limit of possibilities for the average student of beginning biology. He will be found clamoring for Anglo-Saxon words when he opens the first chapter to read:

> To study the problems of life apart from their cosmic relations is to lose much of their significance. It is only by an appreciation of the endless changes—integrations and disintegrations—that pervade the universe that one comes to realize that those qualities by which we recognize living substance more or less closely correspond to the qualities of all substance and those forces by which it is animated to those forces by which the universe itself is controlled.

The medical side of the book is evident in the later chapters of the volume, such as

[3] "Einführung in die Biologie," Teubner, Leipzig, 1909. (Stechert.)

[4] "Biology, General and Medical," Saunders, Philadelphia, 1910.

Blood Relations, Parasitism, Grafting, Senescence and Mutilation and Regeneration. When it is considered that more than nine tenths of the students taking the course in beginning biology go no farther in that department, we come to realize that our course should be so shaped that this great majority receive the consideration, and not the few who later become students in higher courses. It is for this reason, if for no other, that the economic side of the subject is warranted. Not that this be overdone. There is a danger that our references become so anthropocentric that we shall need another Galileo; man must be kept in his proper relation with the universe at large, and bacteria, moulds, pathogenic protozoa and antibodies must be seen to be part and parcel of this universe and not designed as helpers or scourges of mankind.

There is in this book a laxity in attention to details that will be discovered by the careful reader. Regeneration and continuous growth are two different things, although the author treats them as one. Mitosis precedes the appearance of the bud in the growing yeast and not *vice versa*. The granular theory of protoplasmic structure is *not* generally conceded. The figure of a typical cell, copied from Huber, is wretched and misleading. But it is easy to tear down and hard to construct. The book is inspiring to the student who looks broadly at the subject and one wishes it were more adapted to the needs of the modern American boy.

Hegner[5] has designed his text to occupy the first half year of a course where the second half year is devoted to vertebrate zoology. But it is not, *sensu strictu*, an invertebrate zoology. It falls in our category, 2*a*, being a biology with especial reference to invertebrates. The attempt is made to present the newer zoology to the beginner. Here we find the figures of Jennings, Yerkes, Morgan—in fact it may be called an American product from cover to cover. Consequently, the student finds himself at home at once among American forms and American names. It is not to be understood, however, that the view is circumscribed and that the data from foreign sources are eliminated.

Leaving aside for the present time the value of introducing the student directly to the unseen world of the protozoa, it may be said that the result is excellent in the light of the labor set before its author. The book-making is good, the illustrations are carefully selected and there is a unity in the volume which appeals very strongly to the reviewer. There are, as before, places where changes in future editions may be suggested. It is discouraging to the student to be introduced to pages of Greek and Latin terms at the outset. Sufficient unto the later pages is the evil thereof; let us not blunt his zeal at the start. The description of photosynthesis is so involved with that of respiration that the average student will not untangle them, and when the statement is made that "one group of processes (respiration) uses the waste products of the other (photosynthesis)" the error is obvious, for while this may be so for a part of the time, the relation does not exist at others (in darkness). As Professor Alexander Petrunkevitch has pointed out, the figure from Dahlgren and Kepner illustrating the alveolar hypothesis of protoplasmic structure is wrong, inasmuch as this theory involves a foam structure and not that of an emulsion. Amitosis should not be given the prominence that it enjoys in the book, whatever the personal views of the author, for the statements are not warranted by recent investigations. Moreover, the selection of Wheeler's drawings of amitosis in the follicles of the insect ovary to illustrate amitosis as a process of cell-*multiplication* is not fortunate, inasmuch as there is only *nuclear* and not cytoplasmic division. Maupas's schema of the effects of isolation from conjugation in *Paramecium* is given, although the text states, rightfully, that the work of Woodruff and others, such as Gregory and Jennings, has led to a different interpretation. Schultze's figures of the development of the sponge are adopted, although there is perhaps nowhere in biology a more difficult bit of

[5] "An Introduction to the Study of Zoology," Macmillan, 1910.

ontogeny to understand and to leave these figures without complete description is to give the student the impression that simple epiboly is involved. These are but passing thoughts and are not in any way meant to detract from the value of the book.

The question, however, remains, how many institutions could equip their students with the apparatus which is practically necessary for the carrying on of work along the lines laid down by Hegner? It will be remembered that the exact studies on the behavior of protozoa were made possible through the application of the Greenough binocular microscope in the hands of Jennings and others. The time necessary for the development of technique for such experimental work had better be spent, in the mind of the present writer, in covering the subject of biology somewhat more broadly. Again, there are not many students in the first year in the subject who could make much of a series of demonstrations of the development of *Cambarus*. It may be that the present writer does not understand fully the *raison d'être* of the book and that the illustrations are not covered in the laboratory. If this is true, why bring into the student's mind at all the intricacies of crustacean development? It does not involve any more completeness, for there are still many things left out of consideration, such as phylogeny. Does embryology rightly form a part of the beginner's training? Above all, dogmatism is the *bête noire* of all teaching. Is it not necessary to be dogmatic in teaching embryology in this course? Can the data be verified by the student?

It is the firm belief of the present writer that the division of the subject into its two grand divisions is a decided loss to the general student. Living things, after all, partake of the same general characters. The more plants are studied in terms of animals, the better they have been understood. The best zoologist is he who has had at the same time the best botanical training. If it be urged that there are few men who are capable of covering the two fields well, the answer may be made that it is so much the more deplorable. Specialization is carried too far even for the good of investigation if the zoologist can not think in terms of plants. The great principles of the science have been formulated by studies upon both plants and animals. A well-marked instance of this is the present-day work in genetics, in sex, in growth and the like. If this is true, why not give the student the advantage of it?

It is the belief of the writer, too, that more than one year can very seldom be given by the general student to any one science. Unless he be a prospective student of medicine, sanitation or biology itself, his major work must of necessity take him into other fields. The deplorable ignorance of the average art student in things biological would be more quickly effaced if he were able to gain in one year a comprehensive course in this subject comparable to that he may receive in physics and in chemistry. To present the subject as zoology and botany defeats the end.

The physicists and chemists have found time from their research to discuss teaching methods in their respective subjects, but the biologist—well, the biologist is made of finer stuff. A symposium upon elementary biology at the American Association, resembling the discussions of the chemists and physicists which have been held in the past, would be most valuable to all who are concerned, directly or indirectly, in presenting the subject to the students of our universities and colleges.

MAX W. MORSE

TRINITY COLLEGE

Metabolism in Diabetes Mellitus. By FRANCIS G. BENEDICT and ELLIOT P. JOSLIN. Carnegie Institute of Washington. 1910.

The book contains 193 tables. It has the detailed record of work on thirteen cases of diabetes, ten classed as severe and three as light. Calorimetric measurements have been made, the carbon dioxide excretion and oxygen absorption recorded, urinary analyses accomplished, and the influence of food observed. It represents the most ambitious attempt yet made in the study of human diabetes and is a

sincere endeavor to elucidate the problems connected with this disease.

One of the most interesting features of this very extensive and laborious piece of work is the discovery of a constantly low respiratory quotient in patients suffering from severe diabetes, which accords with theoretical expectations.

On page 211, the authors state that after giving beefsteak to a diabetic, "the excretion of sugar in the urine . . . was not sufficient to indicate the excretion of a large part of the non-nitrogenous portions of the steak in the urine." But the sugar rose from 3.1 grams per hour to 8.6, an increase of 5.5 at the same time that the nitrogen elimination rose from 0.57 to 1.25, an increase of 0.68 grams per hour, which corresponds to increased protein destruction of 4.3 grams! According to this computation, 5.5 grams of dextrose might have arisen from 4.3 grams of protein which certainly does not support the negation quoted above.

The reviewer is forced to disagree with the main contention of the book, that the heat production in severe diabetes is 15 per cent. higher than the normal. The error of Benedict and Joslin is twofold. In the first place, their group of normal individuals, nine in number, include three weighing respectively 74, 80 and 83 kilograms. These are not fairly comparable with diabetics weighing between 45 and 65 kilograms. In the second place, the high metabolism obtained from a diabetic individual weighing 45 kilograms who was "extremely highstrung, nervous and apprehensive," and "not an ideal subject," plays quite a part in the average results upon the diabetic patients. If the heavier, normal individuals be excluded, then six weighing between 48 and 67 kilograms produce 1.27 calories per kilogram per hour, and if the excitable diabetic be excluded, it is found that five individuals with severe diabetes and weighing between 49 and 65 kilograms, show an average heat production of 1.34 calories per kilogram, which is an increase of 5 per cent. above the normal, or about that obtained by other observers.

GRAHAM LUSK

SCIENTIFIC JOURNALS AND ARTICLES

THE contents of *Terrestrial Magnetism and Atmospheric Electricity* for March, 1911, are as follows:

"Two New Types of Magnetometers made by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington," J. A. Fleming.

"The Peculiar Magnetic Disturbances of December 28–31, 1908," R. L. Faris.

"On a Variation in the Intensity of the Penetrating Radiation at the Earth's Surface Observed May 19 and 21, 1910," A. Thompson.

"Le Projet du Levé Magnétique de l'Empire Russe et les Travaux Magnetiques," M. Rykatchew.

"The Physical Theory of the Earth's Magnetic and Electric Phenomena. No. III. The External Electric Currents and the Earth's Magnetization," L. A. Bauer.

"Magnetic Storms Recorded at the Cheltenham Magnetic Observatory, October 1 to December 31, 1910."

"Atmospheric Electricity Observations on the *Belgica* in 1907," H. F. Johnston.

SPECIAL ARTICLES

NOTE ON A CONGLOMERATE DIKE IN ARIZONA

WHILE mapping the surface geology of Silverbell, Pima County, Ariz., in connection with a study of the ore deposits of that district, the writer found a conglomerate dike which seems to differ enough from the majority of clastic dikes previously described to justify a short note on its occurrence and probable origin.

On a claim known as C. M. C. No. 4, about a mile north of the town, one of the many intermittent streams of the region has cut a gulch in a dark-colored quartz-porphyry. In the bottom of this gulch and running parallel to it is a vertical fissure from six to eight inches in width filled with a hard compact mass of fragmental material. The fragments are generally angular and vary in size from grains of exceeding fineness to pieces of rock two inches or more in diameter. The greater part of the material is the quartz-porphyry that forms the walls, but a variety of other igneous rocks known to occur in the hills beyond the head of the gulch is also notice-

able. The depth of the fissure is unknown, but the drop in the stream bed showed a downward extent of six feet in which there was no perceptible decrease in width. The dike is parallel to the jointing in the porphyry and can be traced for over fifty feet before it pinches out. It is marked by a number of pinches and swells, giving the formation the appearance of several long, thin, connected lenses of conglomerate standing vertically in the porphyry.

The obvious explanation is that a fissure in the igneous rock has been filled by stream wash, afterwards cemented by calcareous waters, but the origin of the fissure is by no means as clear. Many of the clastic dikes hitherto described have been attributed to the squeezing up from below of fragmental material, while in those filled from above there usually has been evidence of considerable local disturbances to account for the formation of the open fissure.[1] For reasons that can not be given here, but which will be given in a forthcoming paper on the district, it is fairly well established that there has been at Silverbell no recent rock movement sufficient to form open cracks in any of the rocks. It seems more probable that the dike in question represents the result of a joint plane enlarged by weathering, and filled in part by the products of this weathering and in part by sediment washed in by the stream. It is therefore a local feature, and bears no relation to the dynamics of the district, although superficially resembling clastic dykes that have been the result of distinct orogenic movements.

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NOTE REGARDING MAIZE FLOWERS

IT may be well to make here the preliminary announcement of some results obtained in the continuation of my studies of the evolution of the "ear" of Indian corn (maize) begun some years ago. It will be recalled that I published in the *Popular Science Monthly* for January, 1906, a paper entitled "What is an Ear of Corn?" in which I homologized the "ear" with the central spike of the ordinary "tassel," of staminate spikelets. Continuing my studies I have now found perfect flowered (hermaphrodite) spikelets in well-developed "ears" occupying the usual lateral position upon the plants. These are fully figured in a paper which is nearly ready for publication under the title of "Perfect Flowers in Maize." It is found that these are produced upon plants that differ markedly from the ordinary type of Indian corn (maize). They are short-jointed, with broad, leathery leaves, and I venture the suggestion that these plants may resemble in some degree the original form from which our common maize was derived. One of the photographs shows the remnants of an abortive second flower in the pistillate spikelet near the well-developed kernel taken from one of these perfect-flowered ears, indicating that these spikelets were once two-flowered.

E. G. MONTGOMERY
THE UNIVERSITY OF NEBRASKA

[1] J. F. Newsom, *Bull. Geol. Soc. Amer.*, Vol. 14, pp. 227–268, and M. R. Campbell, *Amer. Geol.*, Vol. 33, pp. 135–137.

THE INDIANA ACADEMY OF SCIENCE

THE twenty-sixth annual meeting of the Indiana Academy of Science was held in Indianapolis, Friday, November 25, 1910. The president of the academy, Professor P. N. Evans, chose as his subject for his annual address, "The Place of Research in the Undergraduate Schools." Forty-two regular papers were presented. Those of most general interest were as follows:

"Plants and Man—Weeds and Disease," Robert Hessler, of Logansport.

"Indiana Municipal Water Supplies," Charles Brossman, Indianapolis.

"Subterranean Drainage in the Bloomington Quadrangle," J. W. Beede, of Bloomington.

"Conservation Problems," Frederick J. Breeze, of Lafayette.

"The Properties and Reactions of Thrombin," L. J. Rettger, of Terre Haute.

"The Nature and Origin of the Fish Fauna of the Plateau of British Guiana," C. H. Eigenmann, of Bloomington.

"A Physiographic Survey of the Terre Haute Area," Charles R. Dryer, of Terre Haute.

"Paleolithic, Neolithic, Copper and Iron Ages

in Shelby County," F. W. Gottlieb, of Morristown.

"The Temperature Coefficient of the Surface Tension of Water," Arthur L. Foley, of Bloomington.

"Gaseous Fermentation in Sweetened Condensed Milk," O. F. Hunziker, of West Lafayette.

"Weed Problem in Indiana," Stanley Coulter, of Lafayette.

"The Water Balance of Desert Plants," D. T. MacDougal, of Tucson, Arizona.

"Indiana Fungi," J. M. Van Hook, of Bloomington.

"An Ecological Survey of the Lower Whitewater Gorge," M. S. Markle, of Richmond, and L. C. Petry.

"Timothy Rusts," A. G. Johnson, of Lafayette.

In the evening Dr. D. T. MacDougal, of the Desert Laboratory, at Tucson, Arizona, gave a very interesting and instructive illustrated lecture on "Desert Days and Desert Ways."

Professor Charles R. Dryer, of Terre Haute, was elected president of the academy and A. J. Bigney, of Moores Hill, secretary.

A. J. BIGNEY,
Secretary

SOCIETIES AND ACADEMIES

THE WASHINGTON ACADEMY OF SCIENCES

THE 67th meeting of the Washington Academy of Sciences was held, under the direction of the president, Dr. F. W. Clarke, at the Cosmos Club on the evening of January 19, 1911.

Dr. F. M. Jaeger, professor of inorganic and physical chemistry in the University of Groningen, Holland, gave an address on "Anisotropic Liquids and so-called Fluid Crystals."

Numerous experimental researches have established the fact that in certain liquids, and under certain conditions, there are forces that act upon the molecules differently in different directions. Hence the conception of the liquid state as one characterized by irregular molecular motion is no longer tenable—a fact that fills the subject with interest and has led to many an ardent discussion.

Dr. Jaeger pointed out the similarity of solid crystals with easy gliding-planes, to liquid ones, and the analogy of their changes to those of polymorphic substances. He also described their phase transitions and in particular showed the properties of substances that melt successively to three or more stable liquid states.

By means of projections he showed such properties of liquid crystals as their form, dichroism and strong birefringence, and made clear his argument that the emulsion theories advanced by some to explain the observed phenomena, are only based upon the misunderstood turbidity due to birefringent liquid phases. He also illustrated the strange phenomena of "enforced" and "spontaneous" pseudo-isotropy, and showed the axial images of clear, uniaxial liquids and their strong rotating power.

Proceeding to the real anisotropic liquids, which he illustrated by the different properties of *p*-azoxypenetol, he discussed the principal differences between the spheres of such liquids and real crystals, their heat motion and their diffraction phenomena when mixed with other substances, and concluded with an elucidation of their magnetic induction.

The formal presentation of the paper and its discussion were followed, after adjournment, by experimental demonstrations to many of the more interested of the audience.

THE 68th meeting of the Washington Academy of Sciences was held at the Cosmos Club on the evening of February 1, 1911, with President F. W. Clarke in the chair.

Dr. W. D. Bancroft, professor of physical chemistry in Cornell University, gave his lecture entitled "A Universal Law."[1]

The many chemists of the audience roundly applauded the claim that all branches of human knowledge are but portions of chemistry—mostly subordinate. They seemed highly to approve the idea of spelling "alchemy" with a double "l," and indeed the speaker's familiarity with things not generally called chemical went far to justify this notion.

The illustrations of the universal law were drawn mainly from that branch of chemistry commonly called biology, and those who still persist in calling themselves biologists instead of chemists accepted in good grace many a humorous and telling side remark.

When the lecture was over and the time for talking back came it seemed that most every one had something to say; but whether biologist or some other sort of chemist, each declared the meeting a great success, and since then has done much to make the "universal law" the universal topic.

W. J. HUMPHREYS,
Recording Secretary

[1] See SCIENCE, February 3, 1911.